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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

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To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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2. WATER CYCLE

2A. General

CHARACTERIZATION AND MODELS OF WATERSHED STORAGE,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-04233

GROUNDWATER TRANSPORT OF A SALT TRACER THROUGH A SANDY LAKEBED,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Biology and Health Physics Div.
D. R. Lee, J. A. Cherry, and J. F. Pickens.
Limnology and Oceanography, Vol 25, No 1, p 45-61, January 1980. 13 Fig, 2 Tab, 35 Ref.

Descriptors: *Mass transfer, *Groundwater movement, *Tracers, *Lakes, *Salts, *Surface-groundwater relationships, *Canada, Dispersion, Advection, Lake beds, Permeability, Shores, Seepage, Sediment-water interfaces, Lake bottom springs, Numerical analysis, Sampling, Electrical conductance, Anisotropy, Hydraulic conductivity, Groundwater transport.

In an investigation of groundwater advection and dispersion in a lakebed, a vertical zone of salt solution was injected between 1.7 and 3 m beneath the shoreline and entered the lake through a large area of lakebed at a reduced concentration. Migration of the tracer pulse and flux to the lake were monitored over a 7 x 8 m area of lakebed by measuring the electrical conductance of water collected from sampling points beneath the lakebed and from seepage meters on the lakebed. The tracer moved horizontally, curved gently upward, and entered the lake through an area of 17 sq m--an area 5.7 times larger than the initial cross-sectional area of the tracer zone. Seepage flux through the sediment-water interface declined exponentially with offshore distance and averaged 240 cu m/yr per meter of shoreline. Results showed that prediction of solute flux from onshore zones of groundwater contamination requires consideration of dispersion (mixing) and the ratio of horizontal to vertical permeability (K sub h:K sub v). Numerical simulations showed that with increasing K sub h:K sub v, tracer- or contaminant-entry areas on the lakebed extend over larger areas and are displaced farther offshore. A K sub h:K sub v of 10 matched the field observations. An analytical model indicated that the observed reduction in peak concentration (a decline to 31% of the initial value over a 6-m flow path) would result from values of longitudinal dispersivity as small as 1 cm. (Visocky-ISWS)
W80-04250

MODELLING AND ANALYSIS OF DATA FROM CATCHMENT STUDIES OF LAND USE CHANGE,
National Research Advisory Council of New Zealand, Wellington.
A. R. Rao, A. I. McKerchar, and A. J. Pearce.
Progress in Water Technology, Vol 11, No 6, p 579-597, 1979. 1 Fig, 40 Ref.

Descriptors: *Watersheds(Basins), *Water quality, *Runoff, *Land use, *Model studies, Mathematical models, Analytical techniques, Regression analysis, Stochastic processes, Hydrology, Hydrographs, Unit hydrographs, Urbanization, Conceptual models, Intervention analysis.

Catchment studies of effects of land use change on water quantity and quality have proliferated in recent years. Careful planning of these studies is necessary to ensure that questions of concern are posed as hypotheses and that the catchments instrumented will provide relevant data for testing the hypotheses. Appropriate analysis methods must be used to establish the significance of observed changes in quantity and quality characteristics. Regression methods have commonly been used but have limited applicability where the variance of the data may have been inhomogeneous. Alternative methods are unit hydrograph studies, conceptual modeling, and stochastic analysis. Unit hydrograph studies have been used to predict changes in storm runoff hydrographs as a result of increased urbanization of catchments. Conceptual models offer an alternative to the control catchment in traditional paired catchment experiments but have not assisted in predicting alterations in discharge resulting from land use change. Recently developed stochastic analysis methods are designed to identify, and to establish the significance of, interventions in stochastic processes. These methods have potential for application, although they are still being developed. (Sims-ISWS)
W80-04254

AGRICULTURAL LAND USE AND ITS EFFECT ON CATCHMENT OUTPUT OF SALT AND WATER--EVIDENCE FROM SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2F.
W80-04259

YIELD AND MACRONUTRIENT CONTENT OF WATER IN RELATION TO PLANT COVER FROM THE SNOW TUSSOCK GRASSLAND ZONE OF EASTERN AND CENTRAL OTAGO, NEW ZEALAND,
Otago Univ., Dunedin (New Zealand). Dept. of Biology.
A. F. Mark, and D. K. Holdsworth.
Progress in Water Technology, Vol 11, No 6, p 449-462, 1979. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Water yield, *Nutrients, *Vegetation effects, Mountains, Grasses, Water balance, Rainfall, Precipitation(Atmospheric), Evaporation, Storage, Fog, Lysimeters, Water resources, Land use, *New Zealand.

A lysimeter approach to water yield within the high altitude snow tussock grassland zone of eastern and central Otago is demonstrating a significant difference in water yield associated with the type and condition of plant cover. From all but one of six sites within the zone of high altitude snow tussock (above about 750 m) the highest yields were associated with unmodified snow tussock grassland which returns 55-68% of the measured precipitation, substantially more than that yielded by a short turf of blue tussock grassland that frequently replaces mismanaged snow tussock in the region, or even from bare soil. Below this zone, in mixed fescue-snow tussock grassland that has been, or currently is being, converted into higher producing exotic pasture wherever topography permits, water yield under snow tussock from one site, associated with relatively low precipitation, was less than 50% of input and was exceeded by both a blue tussock sward and bare soil. Evidence was produced which indicates that substantial interception gains from fog by the tall fine foliage provided by a snow tussock canopy is the main factor accounting for the increased yield associated with this type of cover at higher altitudes within the region. This moisture source is not available to either a short grass turf or bare soil. Macronutrient levels of both rainfall and leachate associated with the snow tussock cover were presented but as yet are insufficient to compile nutrient budgets. Levels were generally in the range of those reported for natural ecosystems elsewhere. (Sims-ISWS)
W80-04260

THE CALIFORNIA WATER ATLAS.
California Office of Planning and Research, Sacramento.
1978. 124 p, 32 Plates, 4 Fig, 10 Tab, 108 Photo, 143 Ref.

Descriptors: *California, *Maps, *Water resources, *Urbanization, *Colorado River, *Central Valley Project, *Administration, *Water districts, *Water requirements, *Economics, *Industrial water, *Recreation, *Water quality, *Water management(Applied), *Water supply, *Water demand, *Conservation, Meteoric water, River systems, Water storage, Oceans, Flood control, Irrigation, Water rights, Boulder Canyon Project Act, Metropolitan Water Dist. of So. Cal., Federal-state water rights conflicts, Legal aspects, Water rights, Floods, Droughts, Recreational demand, Hydroelectric power, Navigation, Water quality control, Deltas, Demand, Supply, Technology, Water conservation, Data collections, *Sacramento Valley(CA), *Hetch Hetchy Valley(CA), Los Angeles water system.

The atlas was developed to provide the average citizen with a single-volume point of access to understanding how water works in California. It treats every aspect of water supply, delivery, and use in California--the nature of the water environment, the changes mankind has made in that environment, the history of water development, the operation of the major natural and artificial water systems of today, the relationship of water pricing to water consumption, the uses of water in industry, recreation, and energy development, the problems of water quality, and the current and emerging questions of water policy for the future. (Preece-ISWS)
W80-04444

2B. Precipitation

THE WEATHER REPORT PREDICTS RAIN--AN ESTIMATION OF WHERE, WHEN, AND HOW MUCH RAIN WILL FALL CAN NOW BE DETERMINED BY FREQUENCY ANALYSIS,
New Haven City, CT.
H. F. Goetz, Jr.
Water and Wastes Engineering, Vol 17, No 1, p 39-40, January 1980. 2 Fig, 1 Tab.

Descriptors: *Rainfall, *Design storm, *Frequency, Duration curves, Watersheds(Basins), Rainfall intensity, Precipitation intensity, Storms, Runoff, Drainage, Design, Curves, Frequency curves, Rating curves, Meteorology, Climatology, Time-intensity curves.

Consideration of the total rainfall amount and time period during which the rainfall occurred has resulted in the meteorological rating of storms. The Connecticut Bureau of Highways has compiled and issued a graph of the rainfall frequency curves for Connecticut which establishes relationships between total rainfall, duration of rainfall, and frequency of occurrence. Time-intensity patterns of storms have already been statistically investigated. Intensity-duration graphs, based upon frequency analysis by the method of extreme values, after Gumbel, have been plotted. This type of graph relates three variables--rainfall intensity, return period or frequency, and duration or time of concentration--for the watershed being investigated. These figures reveal that while the storm has only one return period in terms of meteorological data, this same storm results in a number of return periods of varying severity depending upon the time of concentration of the individual shed. Also, since intensity ranking of storms does not consider the areal pattern of the storm, it may not give the same results as obtained from a frequency-discharge curve for the shed. (Sims-ISWS)
W80-04211

ACID PRECIPITATION IN THE WESTERN UNITED STATES,
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2K.
W80-04213

EFFECTIVE RAINFALL ESTIMATION,
Technical Univ. of Prague (Czechoslovakia). Dept. of Irrigation and Drainage.
For primary bibliographic entry see Field 2G.
W80-04231

CONSTANT-RAINFALL INFILTRATION,
Technical Univ. of Prague (Czechoslovakia). Soil Science Lab.

For primary bibliographic entry see Field 2G.
W80-04232

SPELLS OF DRY DAYS RELATED TO AGRICULTURAL DROUGHT IN INDIA,
Meteorological Office, Poona (India).
A. Chowdhury, S. S. Gokhale, and G. S. Rentala.
Mausam, Vol 30, No 4, p 501-510, October 1979. 5 Fig, 3 Tab, 7 Ref.

Descriptors: *Droughts, *Rainfall, *Semiarid climates, Dry seasons, Distribution patterns, Precipitation(Atmospheric), Agriculture, Data processing, Statistics, Analytical techniques, Climatology, Weather, Meteorology, *India.

Efficacy of dry spells in identifying drought-prone areas has been advanced in this study. For this purpose, daily rainfall from 1 June to 31 October, which nearly covers all growth phases of crops grown principally during kharif season for a 70-year period (1901-1970), for 26 stations in Maharashtra State, were analyzed. Two types of dry days were classified, namely, a day receiving less than 2.5 mm of rainfall and receiving less than 6.3 mm of rainfall. Dry spells for both categories were computed and analyzed. Similarly, probabilities of occurrence of dry spells of different lengths were analyzed. A theoretical distribution was also fitted to dry spells. The study revealed that logarithmic distribution nearly represents both categories of dry days. Analysis of dry spells and the probabilities confirmed that the hard-core of the drought in Maharashtra State is located over Ahmednagar district. Other areas which possess high degree of drought proneness are eastern parts of Pune, Satara, and Sangli districts and western parts of Sholapur, Aurangabad, and Bhir districts. In the coastal belt of Konkan and eastern parts of Vidarbha, the drought menace is comparatively less. (Sims-ISWS)
W80-04237

STUDY OF NORMAL RAINFALL OF SATARA DISTRICT,
Regional Meteorological Center, Bombay (India).
A. K. Mukherjee, B. Shyamala, and R. Mazumdar.
Mausam, Vol 30, No 4, p 493-500, October 1979. 6 Fig, 4 Tab, 3 Ref.

Descriptors: *Rainfall, *Distribution patterns, *Climatology, Forecasting, Weather forecasting, Precipitation(Atmospheric), Mountains, Elevation, Water resources, Semiarid climates, Statistics, Analytical techniques, Meteorology, Weather, *India, *Satara District(India).

Issue of districtwise Farmers' Weather Bulletin in its present form is too general to be of any specific use to the farmer. It was felt that attempts should be made to improve the Farmers' Weather Bulletins, and a beginning in this direction was made with a detailed study of rainfall characteristics over Madhya Maharashtra. It was often seen that there is wide variation in the intensity and distribution of rainfall even within the same district. A study of such rainfall characteristics of Satara district in south Madhya Maharashtra was undertaken. A rough line of delineation running north-south across the district was suggested which distinguishes the rainfall distribution in the talukas to the west and the talukas to the east. (Sims-ISWS)
W80-04238

ROLE OF TREE-RING ANALYSIS AND RELATED STUDIES IN PALAEO-CLIMATOLOGY: PRELIMINARY SURVEY AND SCOPE FOR INDIAN REGION,
Institute of Tropical Meteorology, Poona (India).
G. B. Pant.
Mausam, Vol 30, No 4, p 439-448, October 1979. 5 Fig, 1 Tab, 30 Ref.

Descriptors: *Dendrochronology, *Climatology, *Trees, *Tropical regions, Forests, Rainfall, Temperature, Semiarid climates, Data processing, Analytical techniques, *India, Dendroclimatology, Tree rings.

The subject of palaeoclimatology and various methods of palaeoclimatological research were introduced as a multidisciplinary approach. The methods of inferring climatological information from the tree-ring analysis and related studies along with relevant details of sample collection and limitations of the method were discussed. Current status of research in dendroclimatology was reviewed and important techniques were summarized. Available literature relating to growth-ring studies for Indian trees was surveyed, and important findings and limitations relevant to planning and establishment of dendroclimatic research in India were discussed. The scope and importance of dendroclimatic research in India in the light of existing information and a complex relationship of tropical climate with the tree-growth characteristics were presented. The trees of Pinus family such as Chir and other conifers along the Himalayan snowline and sub-Himalayan mountains with relatively prominent ring structure were believed to show a significant response to temperature and snowfall. Maintenance of favorable water balance throughout the year for the trees in the regions of scanty rainfall and occasional droughts is essential for their proper growth. Study of the interaction between various climatic factors during the growing season and possible effects of previous seasons on tree growth is essential for orchard owners and forest planners in these regions. Therefore, the urgent need for an intensive study of response of certain tree species in semiarid tropical regions of India to rainfall, in particular the instances of severe droughts, was recommended. The optimum water balance requirements of plant communities can be estimated on the basis of the statistical relationship between the growth parameters and the seasonal rainfall amounts. A comparison of growth parameters of trees from reserve forests and largely inhabited regions of similar climatic zones may bring out much demanded information about the role of forests on the ecological balance. (Sims-ISWS)
W80-04241

AN EFFECTIVE ANTIFREEZE FOR STORAGE RAINGAUGES,
Ministry of Works and Development, Christchurch (New Zealand), Water and Soil Div.
M. J. McSaveney.
Journal of Hydrology (New Zealand), Vol 18, No 1, p 52-54, 1979.

Descriptors: *Antifreeze, *Rain gages, *Gages, Rain water, Rain, Alcohols, Hydrometers, Rainfall, Temperature, Water, *New Zealand, *Storage rain gages, Commercial antifreeze, Rain gage antifreeze, Methylated spirits, Water-antifreeze solution, Ice needles, Wood alcohol.

Commercial antifreeze will not protect a storage rain gage from freezing: it is too dense and does not mix with rainwater without stirring. The right density for an effective rain gage antifreeze is about 0.995 kg/l, so that the undiluted antifreeze floats between the evaporation-inhibiting oil layer and the water-antifreeze mixture. Such an antifreeze is self-stirring during rain. An antifreeze of this density was made by mixing almost equal quantities of commercial antifreeze and methylated spirits. A slight excess of the latter lighter alcohol was needed, and the correct density was best achieved when a hydrometer was used to test the mixture. The amount of mixture needed for adequate protection must be determined by experience. It varies between gage types and capacities, with rainfall and winter temperature, and even with the frequency of reading. (Roberts-ISWS)
W80-04243

STUDIES OF SILVER IODIDE ICE-FORMING ACTIVITY: VERIFICATION OF THEORY,
Akademiya Nauk SSSR, Novosibirsk. Inst. of Chemical Kinetics and Combustion.
B. Z. Gorbunov, N. A. Kakutkina, and K. P. Koutzenogii.
Journal of Applied Meteorology, Vol 19, No 1, p 71-77, January 1980. 6 Fig, 26 Ref.

Descriptors: *Cloud seeding, *Silver iodide, *Particle size, *Model studies, Mathematical models, Temperature, Air temperature, Weather modification, Precipitation(Atmospheric), Rainfall, Fog, Freezing, Condensation, Crystals, Laboratory tests, Theoretical analysis, Aerosols, Meteorology, Cloud physics.

The dependence of the ice-forming activity on particle radius over the range 50 to 3000 A at fog temperatures of -5, -10, and -20C has been obtained. It was found by diffraction methods that silver iodide particles either have a hexagonal or a cubic low-temperature structure, depending on their size. With these data, the temperature dependences of the threshold particle radius were obtained for hexagonal and cubic modifications of silver iodide. These dependences were compared to theoretical ones obtained by Fletcher for various models of ice formation. It appears that neither the sublimation nor the freezing models describe the experiment. Taking into account the process of water condensation on silver iodide aerosol particles does not improve the situation. A comparison with the Fletcher theory of ice formation on particles with nonuniform surfaces was carried out. It was shown that there are no values of the theoretical parameters which will give a good fit to theory and experiment. (Sims-ISWS)
W80-04244

2C. Snow, Ice, and Frost

SYMPOSIUM ON GLACIER BEDS: THE ICE-ROCK INTERFACE.
Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, 1979. 445 p.
Glen, J.W., Adie, R.J., Johnson, D.M., Homer, D.R., and MacQueen, A.D., editors. Published by the International Glaciological Society, Cambridge (England).

Descriptors: *Conferences, *Glaciology, *Ice, *Interfaces, *Beds, Reviews, Movement, Glaciers, Remote sensing, Erosion, Glaciohydrology, On-site investigations, Sediments, Physical properties, Melt water, Energy dissipation, Streams, Glaciation, Deformation, Melting, Temperature, Abrasion, Laboratory tests, Model studies, Boundary processes, Ice sheets, Ice-rock interfaces, Regelation.

The symposium objectives were to provide a review of the present (1977) state of knowledge of glacier beds and to report on recent and current work. The subject areas covered were: erosion and deposition processes, the nature of the ice-rock interface, the sliding boundary condition, physical and chemical properties of debris-laden basal ice, remote sensing, physical and chemical processes at the glacier bed, conditions at the base of Pleistocene ice sheets, and subglacial hydrology. (See W80-04314 thru W80-04339) (Humphreys-ISWS)
W80-04313

PROCESSES OF GLACIER EROSION ON DIFFERENT SUBSTRATA,
University of East Anglia, Norwich (England). School of Environmental Sciences.
G. S. Boulton.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 15-38, 1979. 9 Fig, 42 Ref.

Descriptors: *Glaciation, *Beds, *Boundary processes, *Erosion, *Reviews, Sediments, Shape, Ice, Glaciers, Abrasion, Bedrock, Movement, Analysis, Analytical techniques, Velocity, Theoretical analysis, Model studies, On-site investigations, Interfaces, Rates, Erosion rates, Deformation, Basal ice, Substrata, Sliding, Drumlins, Flutes.

Most theories of glacier movement and subglacial erosion have assumed that glaciers rest on rigid bedrock surfaces. While this is probably correct for much of the bed area of most modern glaciers, deformable sediments do occur beneath them and formed a substantial area of the beds of large ice sheets during glacial periods. Observations and theories were presented and reviewed about the processes of glacier erosion of rock and unlithified

sediment beds both when they are frozen and unfrozen. Erosional bedrock landforms, such as roches moutonnees, indicate two principal subglacial erosional processes, plucking and abrasion. Where supraglacially derived debris is unimportant, plucking provides the tools which abrade the bed, and must be a quantitatively more important process than abrasion, though more localized. Where plucking is suppressed, erosion rates must be slow. Subglacial measurements of abrasion rates beneath a temperate glacier were used to test an earlier abrasional theory. The form of the predicted abrasion-rate curve for changing ice velocity and pressure was verified. This theory successfully simulates two-dimensional erosional bedforms. Subglacial observations demonstrate how flow of basal ice around the flanks of bedrock obstacles causes streaming of debris to occur. It was suggested that this streaming process is primarily responsible for the longitudinally lineated form of large-scale surfaces typical of glacially eroded bedrock. Plucking and abrasion also occur beneath cold ice, though at slow rates, and are probably restricted to places where the ice thickness is small. Where the glacier bed is composed of unlithified sediment, subglacial measurements show that deformation can produce very large discharges of subglacial material, which makes this a potential agent of very rapid subglacial landform production. The heterogeneity of subglacial sediment leads to spatially variable rates of deformation, and it was suggested that relatively stronger parts of the sediment body may form the nuclei for drumlin and mega-flute formation. Whereas unlithified unfrozen sediment deforms beneath the glacier rather than being incorporated within it, ice-cemented subglacial sediments can behave like bedrock, because of their relative rigidity, and are readily plucked and incorporated englacially. They may also deform beneath the glacier. (See also W80-04313) (Humphreys-ISWS)
W80-04314

A THEORETICAL MODEL OF GLACIAL ABRASION,
Stanford Univ., CA. Dept. of Geology.
B. Hallet.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 39-50, 1979. 6 Fig, 17 Ref. NSF EAR77-13631.

Descriptors: *Glaciation, *Abrasion, *Beds, *Model studies, *Boundary processes, Ice, Erosion, Theoretical analysis, Interfaces, Mathematical models, Analytical techniques, Movement, Glaciology, Glaciers, Loads(Forces), Deformation, Melting, Basal ice, Sliding.

Preliminary results of a quantitative model of glacial abrasion were presented. The analysis, which was constructed within a framework of modern glaciological views of processes near to the bed, was aimed at modeling abrasion under a temperate glacier whose basal layers contain only occasional rock fragments. It does not simulate abrasion by debris-rich ice or by subglacial drift. Calculations of abrasion-rates reduce to evaluations of the forces pressing rock fragments against the glacier bed and of the rates at which they are moved along the bed. The estimated viscous drag induced by ice flow toward the bed due to basal melting is generally the dominant contribution to this contact force. Several new results are noteworthy: (1) other parameters being equal, abrasion will tend to be fastest where basal melting is most rapid, (2) glacier thickness does not affect abrasion through its influence on basal pressures, and (3) lodgement of rock fragments is only possible if the sliding velocity is very low, equivalent to the rate of basal melting. (See also W80-04313) (Humphreys-ISWS)
W80-04315

SIMULATED GLACIAL ABRASION,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
W. H. Mathews.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 51-56, 1979. 2 Fig, 5 Ref.

Descriptors: *Glaciation, *Abrasion, *Laboratory tests, *Model studies, Laboratory equipment, Erosion, Beds, Instrumentation, Boundary processes, Methodology, Loads(Forces), Friction, Friction coefficient.

Glacial abrasion has been simulated by turning a grindstone made of ice and crushed quartz between two stone plates within a domestic deep-freeze. Within limits, the speed of rotation, the normal loading, and the temperature of operation can be controlled. The tangential force exerted on one of the stone plates can be measured. The ratio of tangential to normal force, the effective coefficient of friction, was found to vary with the 'roughness' of the grindstone, to increase gradually as abrasion proceeds, and to increase with decreasing velocity. Even at very low temperatures (to -26C), abrasion products accumulated in a pad of ice frozen to the tablet 'down-stream' from the grindstone, indicating that a water phase at least momentarily exists. The abraded surface of a fine-grained limestone displays grain-from-grain plucking dominating over abrasion of individual crystals. The abraded surface of a granite, by contrast, shows striations of crystals and rupture of cleavage along individual striae. (See also W80-04313) (Humphreys-ISWS)
W80-04316

THE SPECTRAL POWER DENSITY AND SHADOWING FUNCTION OF A GLACIAL MICRORELIEF AT THE DECIMETRE SCALE,
Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
J-P. Benoist.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 57-66, 1979. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Glaciation, *Beds, *Topography, Shape, Profiles, On-site investigations, Analytical techniques, Analysis, Shear, Bedrock, Statistical methods, Wavelengths, Measurement, Statistics, Spectral analysis, Spectral power density.

Longitudinal profiles of roches moutonnees were measured once every centimeter over a total length of more than 100 m. Only wavelengths in the range 3.6 cm less than lambda less than 40 cm were kept and analyzed. Levels and their slopes have a symmetrical, non-Gaussian distribution. The spectral power density varies roughly as gamma times nu to the -m power (nu = wavenumber = 1/lambda); n being the same for all the profiles (n = 2.36) and gamma being dependent on the studied area. No significant difference has been found for the shadowing function of the different studied areas. It seems that few parameters can quantitatively describe roches moutonnees; among these are the distribution of slopes and levels, the spectral power density, and the shadowing function. (See also W80-04313) (Humphreys-ISWS)
W80-04317

LOCAL FRICTION LAWS FOR GLACIERS: A CRITICAL REVIEW AND NEW OPENINGS,
Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
L. Lliboutry.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 67-95, 1979. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Glaciers, *Friction, *Reviews, *Model studies, *Boundary processes, Velocity, Glaciology, Movement, Mathematical models, Analytical techniques, Theoretical analysis, Bedrock, Beds, Ice, Rheology, Melting, Interfaces, Freezing, Heat balance, Mechanical properties, Viscosity, Drag, *Friction laws, Sliding.

'Sliding velocity' and 'friction law' were precisely defined. Different scales for tackling glacier dynamics were introduced. The energy balance in the melting-refreezing process was clarified. The validity of a Glen body as a model for ice rheology was discussed. The assumed model for subglacial water is a very slightly pervious ice, and a not absolutely watertight ice-bedrock interface, owing to glacial striae and rock joints. Then autonomous hydraulic regimes and cavities at water vapor pressure have a negligible influence on the drag, and only the interconnected regime has to be considered. A more rigorous treatment of Weertman's model (independent knobs) gives quite different numerical factors. In general a term increasing with Terzaghi's effective pressure N has to be added to the drag. The double-valued friction law found by Weertman was shown to have been an error. Kamb's relations for the model with a vanishing microrelief are considerably simplified. His conjectural solution cannot be extended to slopes actually found in the microrelief. The author's (Lliboutry, 1968) treatment was unsatisfactory and included an error. With a model consisting of irregular bumps of similar length, a new friction law was given. The pertinent measure of the bedrock roughness is then the shadowing function, not the spectral power density. (See also W72-02284 and W80-04313) (Humphreys-ISWS)
W80-04318

THE UNSOLVED GENERAL GLACIER SLIDING PROBLEM,
Northwestern Univ., Evanston, IL. Dept. of Materials Science and Engineering.
J. Weertman.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 97-115, 1979. 5 Fig, 73 Ref.

Descriptors: *Glaciology, *Boundary processes, *Reviews, *Theoretical analysis, Movement, Ice, Interfaces, Beds, Surfaces, Analytical techniques, Mathematical models, Erosion, Shape, Creep, Deformation, Rheology, Sliding, Basal ice, Roughness(Beds).

The status of the theory of glacier sliding was reviewed. The theory of Nye and Kamb essentially solves the problem of glacier sliding when the basal ice is in intimate contact with a nondeformable bed, but experimental work is needed on cyclic creep and the regelation process in order to put better numbers into the theory. The outstanding problem that remains to be solved, called in this paper the general glacier sliding problem, is the case of sliding when basal ice is not in intimate contact with a nondeformable bed because of the presence of cavities and a water film of finite thickness. This problem involves solving an intricately coupled basal water-flow problem. A new field of research is the study of the motion of glaciers over deformable beds. (See also W80-04313) (Humphreys-ISWS)
W80-04319

THE FLOW OF ICE, TREATED AS A NEWTONIAN VISCOUS LIQUID, AROUND A CYLINDRICAL OBSTACLE NEAR THE BED OF A GLACIER,
Institute of Hydrology, Wallingford (England).
E. M. Morris.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 117-129, 1979. 2 Fig, 21 Ref, 1 Append.

Descriptors: *Ice, *Flow around objects, *Boundary processes, *Mathematical studies, Glaciology, Viscous flow, Flow, Theoretical analysis, Movement, Equations, Analytical techniques, Fourier analysis, Regelation.

This paper described an analytical solution of the equations of motion and heat conduction for ice flowing around a cylindrical solid inclusion and over a solid plane boundary. This is intended to be a simplified representation of the flow of clean glacier ice around a stone and over a rigid rock bed. The ice is treated as a Newtonian viscous

liquid, and the equations are solved in two dimensions. Regelation boundary conditions are applied at both ice-rock interfaces. It was found that finite solutions for the temperature and stream function only exist for the special cases in which two dimensionless critical wavelengths are zero. That is, unless the stone is very far from the glacial bed, the classical regelation boundary conditions cannot be obeyed over the whole of its surface. (See also W80-04313) (Humphreys-ISWS)
W80-04320

A MATHEMATICAL APPROACH TO THE THEORY OF GLACIER SLIDING,
Trinity Coll., Dublin (Ireland). School of Mathematics.
A. C. Fowler.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 131-141, 1979. 2 Fig, 20 Ref.

Descriptors: *Ice, *Boundary processes, *Mathematical models, *Flow, Glaciology, Theoretical analysis, Analytical techniques, Interfaces, Movement, Viscous flow, Bedrock, Beds, Shape, Equations, Velocity, Mathematical studies, Model studies, Basal ice, Sliding.

Previous theories of glacier sliding are subject to the criticism that they are not properly formulated. This paper described how the basal ice flow may be related to the bulk ice flow by means of the formal mathematical method of matched asymptotic expansions. A complete model of the basal sliding (involving coupled problems in ice, water film, and bedrock) may be rationally reduced by a dimensional analysis to a consideration of the ice flow only, and regelation may be neglected provided roughness is absent on the finest scales (less than 1 mm). If the viscosity is supposed to be independent of the moisture content, then complementary variational principles exist that allow bounds on the drag to be obtained. In particular, these determine the magnitude of the basal velocity in terms of two crucial dimensionless parameters. Arguments were presented as to why realistic sliding laws should be taken as continuous functions of the temperature, and a (major) consequence of this assumption was mentioned. Finally, the effect of cavitation was discussed via an (exact) leading-order solution of the ice flow in the particular case of a Newtonian fluid and a 'small' bedrock slope. (See also W80-04313) (Humphreys-ISWS)
W80-04321

SIMULATED GLACIER SLIDING OVER AN OBSTACLE,
Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
R. Brepson.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 143-156, 1979. 14 Fig, 1 Tab, 13 Ref, 1 Append.

Descriptors: *Model studies, *Glaciers, *Movement, *Laboratory tests, Interfaces, Boundary processes, Ice, Viscometers, Laboratory equipment, Methodology, Glaciology, Drag, Analytical techniques, Petrology, Creep, Strain, Measurement, Shear, Beds, Sliding.

The sliding of temperate ice over two obstacles with sine-wave profiles (wavelength, 0.53 m; maximum slope, 0.22) and low thermal conductivity has been reproduced at full scale within a steel chamber. As expected, large cavities form between the ice and the obstacles so that the drag is limited. However, the delayed elasticity of bubbly ice modifies the expected behavior. At the base of the ice a fine-grained, bubble-free blue ice layer develops. The shear strain concentrates on the upstream side of bumps and in the blue ice layer. Tap-water ions enhance tertiary creep-rates. (See also W80-04313) (Humphreys-ISWS)
W80-04322

EMPIRICAL STUDIES OF ICE SLIDING,
Department of Science, Melbourne, Victoria (Australia). Antarctic Div.
W. F. Budd, P. L. Keage, and N. A. Blundy.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 157-170, 1979. 8 Fig, 2 Tab, 27 Ref.

Descriptors: *Ice, *Boundary processes, *Friction, *Laboratory tests, Interfaces, Glaciology, Methodology, Laboratory equipment, Analytical techniques, Analysis, Velocity, Erosion, Shear stress, Beds, Shape, Measurement, Movement, Rates, Sliding, Normal stress, Basal ice, Friction coefficient.

An experimental program was carried out for studying temperate-ice sliding over rock surfaces with a wide range of roughnesses, for normal and shear stresses comparable to those expected under real ice masses. The limiting static shear stress for acceleration was found to be directly proportional to the normal load giving a constant limiting coefficient of static friction characteristic of the surface. For a constant applied normal stress N and shear stress tau, well below the limiting static shear, a steady velocity V results which increases approximately proportionally to tau and decreases with increasing N and the roughness of the surface. For high normal stress the velocity becomes approximately proportional to the shear stress cubed and inversely proportional to the normal stress. As the shear stress increases, acceleration sets in, which for different roughness and normal loads, tends to occur for a constant value of the product tau times V. For some surfaces at high normal loads this acceleration was retarded by erosion. For constant-applied-velocity tests a steady shear stress resulted, which tended to become constant with high velocities, and which increased with increasing normal stress but with a reduced coefficient of sliding friction. The relevance of the results to the sliding of real ice masses was discussed with particular reference to the importance of the effect of the relative normal stress, above basal water pressure, to the sliding rate. It appears that the results presented can provide the basis for a sliding theory which has relevance to the sliding of ordinary glaciers and also to ice falls, surging glaciers, and fast-outlet polar glaciers. (See also W80-04313) (Humphreys-ISWS)
W80-04323

SEISMIC EVIDENCE FOR DISCRETE GLACIER MOTION AT THE ROCK-ICE INTERFACE,
Geological Survey, Menlo Park, CA.
C. S. Weaver, and S. D. Malone.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 171-184, 1979. 8 Fig, 14 Ref.

Descriptors: *Interfaces, *Seismic studies, *Glaciology, *Washington, Ice, Glaciers, Bedrock, Movement, On-site tests, On-site investigations, Avalanches, Seismic waves, Monitoring, Seasonal, Seismic properties, Travel time, Velocity, *Icequakes, Ice-rock interface, Sliding.

Seismic monitoring on three Cascade volcanoes in Washington State has shown that small seismic events are generated by the active glaciers found on each mountain. Detailed seismic experiments have been conducted to investigate the sources for these icequakes. Considerable evidence indicates that the events are the result of a stick-slip type of motion taking place at the bed of the glaciers. The few events the authors have been able to locate had depths comparable with the glaciers' thickness. The similarity of wave form from an explosion at the bottom of a glacier and natural icequakes suggests that the complexity of the seismic wave form is due to the path and not the source. The events exhibit an annual trend with more events being recorded in the summer than during the winter. A tenfold increase in the number of events preceded a large ice avalanche that involved the entire glacier thickness, suggesting that seismic monitoring may be useful in predicting catastrophic ice movements. (See also W80-04313) (Humphreys-ISWS)
W80-04324

ON THE ORIGIN OF STRATIFIED DEBRIS IN ICE CORES FROM THE BOTTOM OF THE ANTARCTIC ICE SHEET,
Cold Regions Research and Engineering Lab., Hanover, NH.
A. J. Gow, S. Epstein, and W. Sheehy.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 185-192, 1979. 5 Fig, 11 Ref.

Descriptors: *Antarctic, *Interfaces, *Ice, *Cores, On-site investigations, Analysis, Sediments, Stratigraphy, Petrography, Particle size, Melting, Ice-rock interface, Ice sheets, Ice cores, Basal debris.

Cores from the bottom 4.83 m of the Antarctic ice sheet at Byrd Station contain abundant stratified debris ranging from silt-sized particles to cobbles. The nature and disposition of the debris, together with measurements of the physical properties of the inclosing ice, indicate that this zone of dirt-laden ice originated by 'freezing-in' at the base of the ice sheet. The transition from air-rich glacial ice to ice practically devoid of air coincided precisely with the first appearance of debris in the ice at 4.83 m above the bed. Stable-isotope studies made in conjunction with gas-content measurements also confirm the idea of incorporation of basal debris by freezing of melt water at the ice-rock interface. It is suggested that the absence of air from basal ice may well constitute the most diagnostic test for discriminating between debris incorporated in a melt-refreeze process and debris entrapped by purely mechanical means, e.g., shearing. It was concluded from observations on bottom cores from Byrd Station that 'freezing-in' of basal debris is the major mechanism by which sediment is incorporated into polar ice sheets. (See also W80-04313) (Humphreys-ISWS)
W80-04325

THE DEBRIS-LADEN ICE AT THE BOTTOM OF THE GREENLAND ICE SHEET,
State Univ. of New York at Buffalo, Amherst. Ice Core Lab.
S. Herron, and C. C. Langway, Jr.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 193-207, 1979. 5 Fig, 2 Tab, 51 Ref.

Descriptors: *Ice, *Interfaces, *On-site investigations, Stratigraphy, Carbon dioxide, Analysis, Particle size, Shape, Gases, X-ray analysis, Quartz, Kaolinite, Crystals, Argon, *Ice cores, *Greenland, Ice sheets, Debris, Basal ice, Ice texture.

The Camp Century, Greenland, ice core was recovered from a bore hole which extended 1375 m from the surface of the Greenland ice sheet to the ice/subice interface. The bottom 15.7 m of the core contain over 300 alternating bands of clear and debris-laden ice. The size of the included debris ranges from particles less than 2 micrometers in diameter to particle aggregates which are a maximum of 3 cm in diameter: the average debris concentration is 0.24% by weight. The debris size, concentration, and composition indicate that the debris originates from the till-like material directly below the debris-laden ice. The total gas concentration averages 51 ml/kg ice compared to the average of 101 ml/kg ice for the top 1340 m. The gas composition of debris-bearing ice has apparently been modified by the oxidation of methane as reflected by traces of methane, high CO2 levels, and low O2 levels with respect to atmospheric air. Argon, which is not affected by the oxidation, shows an enrichment in samples with lower gas concentrations. Both the low gas concentration in the debris-laden zone and the argon enrichment may be explained by the downward diffusion of gases from bubbly glacier ice into an originally bubble-free zone of refrozen debris-laden ice. Ice texture and ice-fabric analyses reveal extremely

fine-grained ice and highly preferred crystal orientation in the lowermost 10 m of the core, indicating a zone of high deformation. (See also W80-04313) (Humphreys-ISWS)
W80-04326

DISCONTINUOUS FLOW, ICE TEXTURE, AND DIRT CONTENT IN THE BASAL LAYERS OF THE DEVON ISLAND ICE CAP,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
R. M. Koerner, and D. A. Fisher.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 209-222, 1979. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Ice, *Soils, *Beds, Analysis, Crystals, Bedrock, Flow, Stratigraphy, Particle size, Oxygen isotopes, *Ice cores, *Devon Island, Basal ice, Ice texture, Ice cap.

Surface-to-bedrock cores obtained with a CRREL thermal drill were taken in 1972 and 1973 from the top of the Devon Island ice cap. There are very pronounced variations in oxygen isotope, microparticle concentration, and ice texture in the lower-most 5 m of the core. There is a section of isotopically cold, very fine bubbly ice with high microparticle concentrations between 2.6 and 4.4 m above the bed, considered to represent the Last Ice Age. There is coarse, isotopically warm, clean ice above and below this. For 1.2 m above the bed, the ice is finer again with high microparticle concentrations, but it shows very low bubble concentration and is isotopically the warmest in the core. While the broad variations are common to both cores, in detail there are significant variations despite the fact that the cores were taken only 27 m apart. The variations, when analyzed statistically, show that at least 25-30% of the originally continuous profile is missing from each core. Faulting within the near-bedrock ice may be responsible for some of the effect, but bubble fabric also gives evidence for irregular nonlaminar flow. Because of the strong relationship between crystal size and microparticle concentrations in the Devon Island cores, it is suggested that the fine-grained nature of dirty layers in the Antarctic and Greenland ice sheets is due to the effect of the dirt inclusions and not of shearing. Steep isotopic gradients in the Devon Island cores are shown to be evidence for possible shearing, which does not effect any change in the crystal texture. Clear ice near the bed is considered a tectonic feature, but the lack of effect on its bed by the ice cap confirms the nonerosional nature of an ice cap frozen to its bed. In terms of paleoclimatic history, it means that, because of bedrock effects, ice caps of intermediate depth (i.e., less than 400 m) can give continuous information only over the last approximate 5000 years. Between 5000 and 10,000 B.P., the time series becomes slightly discontinuous and beyond 10,000 B.P. so discontinuous as to allow only broad climatic inferences to be drawn. (See also W80-04313) (Humphreys-ISWS)
W80-04327

DEPOLARIZATION OF RADIO WAVES CAN DISTINGUISH BETWEEN FLOATING AND GROUNDED ICE SHEETS,
Natural Environment Research Council, Cambridge (England). British Antarctic Survey.
A. H. W. Woodruff, and C. S. M. Doake.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 223-232, 1979. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Ice, *On-site investigations, *Remote sensing, *Antarctic, Radio waves, Sounding, Analytical techniques, Analysis, Electromagnetic waves, Anisotropy, Beds, Surveys, Methodology, On-site tests, Movement, Floating, Ice sheets, Grounded ice, Ice shelf, Echo sounding, Ice thickness.

Polar ice is now thought to be marginally birefringent at radio echo-sounding frequencies. An experiment on the polarization behavior of 60 MHz radio echoes from the bed of both ice shelf and land ice in Antarctica showed a marked difference in the returned polarization. It appears that differences in electrical properties or roughness of the reflecting boundary cannot explain the results. It is suggested that there is a large change in the birefringence of the ice sheet at the hinge zone, caused by the effect of tidal strain on crystal orientation. This would imply a minimum value of the radio-frequency anisotropy in permittivity for the single crystal of (0.52 + or - 0.8)%; therefore, polarization changes could allow floating and grounded ice to be distinguished. (See also W80-04313) (Humphreys-ISWS)
W80-04328

ENERGY DISSIPATION DURING SUBGLACIAL ABRASION AT NISQUALLY GLACIER, WASHINGTON, U.S.A.,
Washington Univ., Seattle. Geophysics Program.
R. C. Metcalf.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 233-246, 1979. 3 Fig, 3 Tab, 35 Ref.

Descriptors: *Glaciers, *Abrasion, *Energy, *Washington, On-site investigations, Sediments, Glacial sediments, Melt water, Ice, Scour, Erosion, Rocks, Model studies, Mathematical models, Glaciology, *Nisqually Glacier(WA).

This study examined the effect of subglacial abrasion on the basal sliding term of the gravitational energy balance of the dynamic, temperate Nisqually Glacier on Mount Rainier, Washington. Subglacial water flux was estimated as 3 x 10 to the 7th power cu m/yr and suspended sediment flux as 3 x 10 to the 7th power kg/yr. Suspended-sediment flux was assumed to represent, within an order of magnitude, the annual mass eroded by subglacial abrasion. Subglacial abrasion involves both brittle fracture and plastic deformation. Field observations of bas-relief and grooved depression striations appear to have exact counterparts in rock mechanics experiments approximating subglacial velocities and normal stresses. Boulton's abrasion model and a new attritivity model proposed herein were shown to predict subglacial abrasion-rates within the limits of natural variability and the error range of measurements. The first crude gravitational energy balance for lower Nisqually Glacier (1.96 sq km) was attempted and probably has only order-of-magnitude accuracy. The importance of subglacial abrasion in dissipating basal sliding energy at Nisqually Glacier was confirmed. (See also W80-04313) (Sims-ISWS)
W80-04329

SEDIMENT CONCENTRATION IN MELT WATERS AS AN INDICATOR OF EROSION PROCESSES BENEATH AN ALPINE GLACIER,
Manchester Univ. (England). Dept. of Geography.
D. N. Collins.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 247-257, 1979. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Sediments, *Melt water, *Glaciers, Sampling, On-site investigations, Suspended solids, Discharge(Water), Ablation, Variability, Sediment transport, Erosion, Data processing, Sedimentology, Glaciology, *Gornera Glacier(Switzerland).

Suspended-sediment concentrations in melt waters from the Gornera, Gornergletscher, Switzerland, were determined at hourly intervals for periods during the ablation seasons of 1974 and 1975. Rapid erratic fluctuations of suspended-sediment concentration produced peaks which occurred both before and after highest daily flows. Clockwise daily hysteresis rating loops between sediment concentration and discharge included many involutions. Suspended-sediment concentration-discharge rating curves were different for rising and falling limbs of individual diurnal hydrographs and varied from day to day. Close-interval measurements of sediment concentration and discharge records allow interpretation of the nature of ice-water-sediment interactions at the bed of an Alpine glacier. At Gornergletscher, subglacial sediment is delivered to melt waters flowing in the smaller basal conduits, which often change course suddenly, entraining unworked sediment stored at the bed. During diurnal discharge maxima, sediment concentration in the Gornera is reduced because the rate of increase of water volume outstrips the rate of supply of sediment. The drainage of the ice-dammed lake Gornersee, producing exceptionally high flows, extended the drainage network over large areas of the glacier bed, and evacuated much sediment. (See also W80-04313) (Sims-ISWS)
W80-04330

PRESSURE-MELTING EFFECTS IN BASAL ICE OF TEMPERATE GLACIERS: LABORATORY STUDIES AND FIELD OBSERVATIONS UNDER GLACIER D'ARGENTIERE,
Cambridge Univ. (England). Cavendish Lab.
D. J. Goodman, G. C. P. King, D. H. M. Millar, and G. de Q. Robin.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 259-271, 1979. 7 Fig, 13 Ref, 1 Append.

Descriptors: *Ice, *Glaciers, *Pressure, *Melting, Laboratory tests, On-site investigations, Strain gages, Bedrock, Heat flow, Temperature, Freezing, Glaciology, *Glacier d'Argentiere(France), Regelation.

The suggestion that patches of basal ice may freeze to the bed of a glacier due to certain regelation effects has been tested in the laboratory by applying high hydrostatic pressures to ice samples at the pressure-melting point. During compression, ice temperatures follow the pressure-melting point closely, but after rapid decompression the ice temperature at first returns only half to three-quarters of the way to the pressure-melting point, after which it appears to warm by thermal conduction from outside the ice sample. If the moving ice at the base of a glacier behaves in the same way as it is exposed to changing pressure fields, frozen patches at bedrock are to be expected. Records of strain variations in a tunnel beneath Glacier d'Argentiere show two types of strain events. The first is a rapid jump or offset in the recorded strain, while the second are strain excursions, initiated by a change in strain over a period up to ten seconds, followed by a gradual recovery to the original strain over some minutes. It was suggested that the offset events are due to nearby stress release due to fracturing of frozen patches of ice at the bedrock, while the strain-excursion events show the more distant adjustment of the glacial bed to the former events due to the time lags associated with changes of water-film thickness and regelation heat flow. (See also W80-04313) (Sims-ISWS)
W80-04331

OBSERVATIONS WITHIN CAVITIES AT THE BED OF THE GLACIER OSTERDALSISEN, NORWAY,
Manchester Univ. (England). Dept. of Geography.
W. H. Theakstone.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 273-281, 1979. 4 Fig, 28 Ref.

Descriptors: *Glaciers, *Ice, *Movement, Deformation, Plastic deformation, Temperature, Strain, Bedrock, Rocks, Glaciology, *Glacier Osterdalsisen(Norway), Subglacial cavities, Regelation, Basal ice.

Basal ice at the glacier Osterdalsisen commonly deforms under stress within cavities at the glacier bed. Some ice subject to rapid strain, however, fails in a brittle manner. The creep-rate of basal ice is influenced by sediment particles within it, and by ice grain-size and structural anisotropy; a flow law for such ice has not been derived experimentally.

Near the glacier bed, particles enclosed in ice may migrate as a result of stress concentration, bubbles may be flattened, and anisotropic structures may develop. Recrystallization leads to grain-size changes. Both regelation spicules and layers of regelation ice, generally thin, form within subglacial cavities, but their occurrence is limited. Regelation-ice formation has a significant influence on the distribution of rock debris at the ceilings of subglacial cavities. (See also W80-04313) (Sims-ISWS)
W80-04332

A SEQUENCE OF GLACIAL DEFORMATION, EROSION, AND DEPOSITION AT THE ICE-ROCK INTERFACE DURING THE LAST GLACIATION: CRANBROOK, BRITISH COLUMBIA, CANADA,
University of Western Ontario, London. Dept. of Geology.
B. E. Broster, A. Dreimanis, and J. C. White.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 283-295, 1979. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Bedrock, *Glaciation, *Geomorphology, *Canada, Deformation, Plastic deformation, Erosion, Deposition(Sediments), Rocks, Till, On-site investigations, Geology, Ice, Fractures(Geologic), Glaciers, Glaciology, *British Columbia.

A comparison of bedrock fractures with orientation of structures and fabric in the overlying late Pleistocene basal till indicated a sequence of common glacial origin. The deformations in bedrock and till, and the deposition of the till layer, were accomplished by two glacial flows that were part of a mountain ice sheet: the regional (moving south-south-east) and the local (moving south-south-west) along Peavine Valley. The following sequence of events was postulated from this investigation: the initial glacial advance from the north-north-west that produced conjugate low-angle shear fractures in the bedrock was followed by competition of both the regional and the Peavine Valley glacial flows which also produced low-angle fracture systems. As the over-riding ice became thicker, high-angle conjugate fractures were formed by both glacial flows. Subsequently, south-east-dripping injection wedges were formed by the regional ice, which was concurrently eroding the down-glacier parts of the wedged blocks, depositing local till, and producing sigmoidal deformations in this till. The main deposition of the overlying lodgement till was accomplished by an interaction of both the regional and the Peavine Valley glacial flows, and the lodgement was supplemented by shearing of the till, producing fissility. Bedrock wedging, as a significant process of glacial erosion, is believed to be discussed here for the first time. (See also W80-04313) (Sims-ISWS)
W80-04333

GIANT GROOVES MADE BY CONCENTRATED BASAL ICE STREAMS,
Ohio State Univ. Research Foundation, Columbus. Inst. of Polar Studies.
R. P. Goldthwait.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 297-307, 1979. 6 Fig, 21 Ref.

Descriptors: *Glaciation, *Erosion, *On-site investigation, *Ohio, Bedrock, Ice, Streams, Beds, Abrasion, Analysis, Surveys, Land forming, Geomorphology, *Kelleys Island(OH), Basal ice, Ice sheets, Glacial grooves, Flutes.

Glacial grooves are known on all the flat-lying limestone islands in western Lake Erie. The largest megagroove complexes are on Kelleys Island, each 2-6 m deep, 5-20 m wide, and 100-400 m long before quarrying. Each megagroove floor is rolling with second-order rounded ridges and 'sine-shaped' grooves 10-90 cm deep and 5-40 m long. Furthermore, these are gouged laterally by sharply curving and nesting gouges up to 10 cm deep. All grooves exhibit third-order striation up to 1-2 mm deep and 5-200 cm long made by individual tools of debris traveling mostly 240-260 degrees. Ice of the Erie lobe was under compressive flow as it rose from 9 m below present lake level to 12 m above. Some sort of ice vortices (fixed eddies in the basal ice stream) are postulated to make the scoop marks and ridge ends. Fast-moving ice rather than water or a slurry is favored because there are no percussion marks. Very likely, a till mat of interfering engraving points is required. A strong convergence (2x to 10x) of striae into the deepest grooves indicates squeezing together of the debris tools and increase in local ice velocity. Interglacial subareal streams may well have shaped the initial trough up which these ice streams concentrated, because dendritic tributary grooves intersect, and main groove sets curve as much as 10 degrees or 20 degrees. Furthermore, sharp 100-180 degrees meander curves are preserved at the bottom of the deepest grooves. Hiram-age clay-till with rare erratics half fills the original grooves; it shows that this groove cutting was completed before 15,500 14C years ago. (See also W80-04313) (Humphreys-ISWS)
W80-04334

DIRECT MEASUREMENT OF BASAL WATER PRESSURES: PROGRESS AND PROBLEMS,
Geological Survey, Tacoma, WA. Water Resources Div.
S. M. Hodge.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 309-319, 1979. 2 Fig, 12 Ref.

Descriptors: *Glaciers, *Boreholes, *Water pressure, On-site investigations, Measurement, Drilling, Drill holes, Pressure, Water levels, Glaciology, *South Cascade Glacier(WA), *Blue Glacier(WA), Basal water, Subglacial water.

In 1975 and 1977, 24 bore holes were drilled to the bed of South Cascade Glacier, Washington, using both electrothermal and hot-water drills. Only two holes connected directly with the basal water system, a significant decrease from the four to five such connections in 13 holes drilled in 1973 and 1974. Most of the bed, possibly as much as 90%, appears to be hydraulically inactive and isolated from a few active subglacial conduits. Bore holes which penetrate these inactive areas initially should connect eventually with the active basal water system due to bed pressurization by the water standing in the bore hole, provided there is a sufficient supply of water available to form and maintain the connection passageway. These sealed-off areas probably consist of the subsole drift and permeability barriers found recently at the bed of Blue Glacier; an increase in the area of bed covered by these features probably caused the decrease in chance of bore-hole connection. This apparently was not due to any external cause but rather was the result of a real internal change in the subglacial hydraulic system which occurred between 1974 and 1975. If most of the area of a glacier bed is hydraulically isolated subsole drift, or something similar, such features may well control large-scale glacier sliding changes, since changes in the amount of water having access to the glacier bed will take considerable time to affect the interstitial water pressure in the more widespread subsole drift. Water pressures in the active part of the basal water system of South Cascade Glacier are generally in the range of 50-75% of the ice overburden pressure. Water levels in a connected bore hole are probably representative over an area of the bed 100 m or more in extent. A correlation of bore-hole water levels with changes in surface motion supports the idea that the sliding of a temperate glacier is controlled largely by the basal water pressure. (See also W80-04313) (Sims-ISWS)
W80-04335

SUBGLACIAL REGELATION WATER FILM,
Stanford Univ., CA. Dept. of Geology.
B. Hallet.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 321-334, 1979. 5 Fig, 41 Ref. NSF EAR77-13631.

Descriptors: *Glaciers, *Chemical precipitation, *Carbonates, *Calcite, Bedrock, Films, Chemical analysis, Geomorphology, Variability, Temporal distribution, Spatial distribution, Glaciology, Regelation, Basal water.

Recent studies of subglacially precipitated carbonate deposits and associated solutional furrows have provided interesting new insight on subglacial water films, as well as on chemical exchange at the glacier bed. Considerable information on the film thickness and its temporal and spatial variability has been gained by analyzing several properties of subglacial carbonate deposits including: (1) the morphology of surface features aligned parallel to ice flow, (2) the laminated structure, and (3) the size distribution of fine rock fragments presumably transported in the film prior to their incorporation in the deposits. Chemical analyses of water from pro-glacial streams, together with calculations of CaCO3 solubility and mass balance, showed that the channelized water is chemically distinct from the film water in which CaCO3 precipitates, and that subglacial precipitation is not possible where there is a considerable water flux through the film in excess of that associated with regelation sliding. The principal implication of these studies was that a temperate cirque glacier is characteristically separated from its bed by a thin water film, probably micrometers in thickness; however, the film appears to occasionally thicken, at least locally by as much as a hundredfold in exceptional cases. Furthermore, the water flux and/or solute concentration in the basal film undergoes periodic, probably seasonal, variations possibly related to variations in the amount of water reaching and flowing through the basal film. (See also W80-04313) (Sims-ISWS)
W80-04336

GEOMETRY OF FORMER SUBGLACIAL WATER CHANNELS AND CAVITIES,
Stanford Univ., CA. Dept. of Geology.
J. Walder, and B. Hallet.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 335-346, 1979. 8 Fig, 31 Ref. NSF EAR77-13631.

Descriptors: *Glaciers, *Bedrock, *Abrasion, *Erosion, Flow, Rocks, Chemical precipitation, Mapping, Geology, Scour, Glaciology, Basal ice, Basal water, Cavities.

The spatial pattern of the formerly active processes of water flow, cavitation, abrasion, dissolution, and precipitation at the base of a small cirque glacier has been reconstructed by detailed mapping of surficial features on recently deglaciated limestone bedrock near the glacier terminus. Interpretation of these features, which reflect basal conditions averaged over a period of several or several tens of years, leads to the following conclusions: (1) A nearly continuous, nonarborescent network of cavities and incised channels existed and probably acted as the primary drainage of melt waters. This network evolved through time as many channels were filled, perhaps intermittently, by basal ice. (2) At least 20% of the glacier sole was separated from the bed by water-filled cavities. The rest of the glacier-rock interface characteristically comprises a very thin water film. (3) Abrasion was locally intensified, relative to chemical alteration, in 5-10 m wide zones paralleling the ice-flow direction, perhaps as a result of locally enhanced sheet flow of subglacial water. (See also W80-04313) (Sims-ISWS)
W80-04337

QUANTITATIVE DETERMINATION OF THE SUBGLACIAL HYDROLOGY OF TWO ALPINE GLACIERS,
Manchester Univ. (England). Dept. of Geography.
D. N. Collins.
In: Symposium on Glacier Beds: The Ice-Rock

Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 347-362, 1979. 5 Fig, 2 Tab, 30 Ref.

Descriptors: *Glaciers, *Hydrology, *Flow, *Discharge(Water), Melt water, Water chemistry, On-site investigations, Model studies, Mathematical models, Sediments, Electrical conductance, Hydrographs, Glaciology, Subglacial hydrology, Flow components.

Two components of discharge through the internal hydrological systems of Alpine glaciers were separated on the basis of chemical composition of water. Some surface melt waters retain low solute contents after flowing without delay through conduits in which no chemical enrichment occurs, whereas those flowing slowly at the glacier bed have increased ionic concentrations. A simple mixing model was used to investigate temporal variations in the quantities of water routed through each of the two subsystems. Electrical conductivity was taken as an indicator of melt-water composition and was monitored for periods during the summer ablation season of 1975 at Gornergletscher and of 1977 at Findelengletscher. At both glaciers, conductivity of melt waters varied diurnally inversely with discharge fluctuations, depending on the proportion of total discharge routed through the two subsystems. Total discharge and the flow component routed rapidly through conduits within the glacier, a large proportion (50-80%) of total discharge, exhibited in-phase rhythmic diurnal hydrographs at the two glaciers. Distinctive subglacial hydrological regimes were contrasted. At Findelengletscher, the hydrographs of total discharge and of subglacial chemically enriched flow were in phase. At Gornergletscher, the subglacial hydrograph occurred with reverse asymmetry and out of phase. A possible interpretation is that water was temporarily stored in basal cavities during high total discharge. During the night, stored water was released, contributing much of the total discharge at times of low flow. (See also W80-04313) (Sims-ISWS)
W80-04338

SUBGLACIAL CONSTRUCTIONS AND INVESTIGATIONS AT BONDHUSBREEN, NORWAY,
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
B. Wold, and G. Ostrem.
In: Symposium on Glacier Beds: The Ice-Rock Interface, Proceedings of a Symposium held at Carleton University, Ottawa (Ontario), August 15-19, 1978. Journal of Glaciology, Vol 23, No 89, p 363-379, 1979. 12 Fig, 2 Tab, 8 Ref.

Descriptors: *Glaciers, *Drainage, *Construction, *Tunnel construction, Ice, Bedrock, Rocks, Till, Tunnels, Tunneling, Flow, Discharge(Water), Hydrology, Glaciology, Subglacial water, Subglacial water intakes, Basal ice, Basal water.

For the construction of a hydroelectric power station in western Norway, a diversion tunnel was made to collect subglacial melt water under an outlet glacier from the Folgefonni ice cap. Many investigations were carried out by glaciologists and engineers before the project could begin, and several unexpected problems arose during the completion of the project. This paper dealt with some of the problems and how they were solved. To avoid coarse glacier-carried material from being flushed into the water-collecting tunnel system, a large sedimentation chamber was constructed in the bedrock under the glacier. The dimensions of this huge chamber were decided from sediment-transport studies in the glacier stream and from studies of old bottom deposits in a lake close to the glacier front. Ice-velocity measurements were made on the glacier surface, and similar studies were attempted in subglacial ice caves made by spraying hot water near the glacier bed, where the ice is 170 m thick. The subglacial water-drainage system was studied from a horizontal tunnel constructed in the bedrock under the glacier. Some preliminary conclusions were drawn from these studies. In future, it will still be possible to undertake subglacial studies because inspection tunnels have been left in the bedrock, and the accessibility is relatively good. (See also W80-04313) (Sims-ISWS)
W80-04339

2D. Evaporation and Transpiration

ESTIMATES OF LAKE ST. CLAIR EVAPORATION,
National Oceanic and Atmospheric Administration, Ann Arbor. MI. Great Lakes Environmental Research Lab.
J. A. Derecki.
Journal of Great Lakes Research, Vol 5, No 2, p 216-220, 1979. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Evaporation, *Lakes, *Mass transfer, *Estimating, Equations, Temperature, Air temperature, Winds, Humidity, Ice cover, Estimating equations, Water temperature, *Lake St. Clair.

Monthly evaporation from Lake St. Clair was determined for individual years of a 26-year period, 1950-75, by the mass transfer method applied to available land-based data adjusted to overwater conditions. Because of extensive ice cover on the lake, the overwater mass transfer results were adjusted for the effect of ice cover during winter. The ice-cover adjustment reduced the average annual evaporation by 100 mm to 750 mm. The mass transfer method is the only technique that permits operational evaporation estimates from this lake with presently available data, and it is also the approach most amenable to future improvements. (Sims-ISWS)
W80-04217

ASSESSMENT OF THE QUALITY OF GENERALIZED WIND FUNCTIONS IN PENMAN'S EQUATIONS,
Dar es Salaam (Tanzania). Dept. of Physics.
C. J. Stigter.
Journal of Hydrology, Vol 45, No 3/4, p 321-331, February 1980. 2 Tab, 29 Ref.

Descriptors: *Winds, *Equations, *Mass transfer, Evaporation, Atmosphere, Water management(Applied), Agriculture, Management, Meteorological data, *Wind functions, *Penman's equations, Bulk mass transfer, Evaporating surface, Potential evaporation, Crop evaporation, Atmospheric instability, Water management problems.

A simplification of the aerodynamical expression for bulk mass transfer over a rough evaporating surface was used to assess the quality of generalized empirical statistical wind functions in Penman's equations. It was shown that Penman's revised wind function for the open water case was good enough to be preferred over any attempt for more adaptations. It was also shown that for the case of potential evaporation, or reference crop evaporation, a recent approach by Doorenbos and Pruitt formed an appreciable improvement. Comparison with another generalization by Thom and Oliver showed that the generalized wind functions preferred held also under conditions of atmospheric instability. Limitations were discussed for using reference crop evaporation formulas with only a generalized wind function in agricultural water management problems. (See also W77-09953) (Roberts-ISWS)
W80-04230

EVAPORATION FROM VEGETATION IN LANDSCAPES DEVELOPING SECONDARY SALINITY USING THE VENTILATED-CHAMBER TECHNIQUE, II. EVAPORATION FROM ATRIPLEX PLANTATIONS OVER A SHALLOW SALINE WATER TABLE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
E. A. N. Greenwood, and J. D. Beresford.
Journal of Hydrology, Vol 45, No 3/4, p 313-319, February 1980. 5 Fig, 4 Ref.

Descriptors: *Evaporation, *Vegetation, *Landscaping, Salinity, Soils, Plant populations, Groundwater, Water table, Transpiration, Shrubs, *Landscapes, *Secondary salinity, Ventilated-chamber technique, Ungrazed plantations, Bare soils, Groundwater levels, Plots, Nocturnal transpiration.

Daytime evaporation from ungrazed plantations of Attriplex vesicaria, of varying spacing between bushes, was determined during summer. Daily evaporation from individual bushes, plus 1 sq m of surrounding soil, declined significantly with increasing closeness of planting (3.3-1.3 mm/d). Evaporation from bare soil between plants was not affected by spacing and averaged 0.4 mm/d. The integration of these two sources of evaporation showed that total evaporation significantly increased with closeness of spacing from 0.7 to 1.3 mm/d. The increase in evaporation was reflected in groundwater levels measured at the center of each plot throughout the summer. The water table under plots with the closest spacing was 10-20 cm deeper (P less than 0.05) than under the widest spacing. This suggested that Atriplex may have a hydrologic role in saltland reclamation in addition to its value as a grazing plant. There was evidence of a low rate of nocturnal transpiration. (Roberts-ISWS)
W80-04273

SUITABILITY OF REGION-WIDE IRRIGATION SCHEDULING BY LOCAL EVAPOTRANSPIRATION MEASUREMENT,
Nebraska Univ. Panhandle Station at Scottsbluff.
W. L. Trimmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-169360, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center, University of Nebraska, Project Completion Report, March 1980. OWRT A-050-NEB (1), 14-34-0001-9029.

Descriptors: *Irrigation scheduling, *Evapotranspiration, *Irrigation design, *Irrigation efficiency, Model studies, Analytical techniques, Instrumentation, Climatology.

Irrigation scheduling requires an estimate of evapotranspiration (ET) to provide a means of determining when to irrigate and with how much water. Measuring ET or crop water use at every site is too expensive. Three sites in the Nebraska Panhandle were chosen as measurement sites. The three formed a triangle approximately 95 km on a side and represented three distinct different climates. Three years ET data for June through August showed relatively little difference between the sites. Norman instrument error explained a great deal of the variation. Instrument calibration, including hygrothermographs and silicon cell pyranometers, proved difficult and illustrated that the fewest number of measurement sites was optimum. Poor calibration can account for far greater differences than climatological differences within a 100-km radius given no great orographic, elevation or micrometeorological differences in location.
W80-04442

2E. Streamflow and Runoff

RUNOFF CURVE NUMBERS FROM PARTIAL AREA WATERSHEDS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
R. H. Hawkins.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 105, No IR4, Proceedings Paper 15024, p 375-389, December 1979. 10 Fig, 2 Tab, 14 Ref, 2 Append.

Descriptors: *Runoff coefficient, *Storms, *Surface runoff, *Watersheds(Basins), Methodology, Hydrology, Hydrologic data, Analytical techniques, Infiltration rates, Antecedent moisture content, *Runoff curve numbers, *Potential site retention, Small watersheds, Initial abstraction.

Runoff curve numbers are coefficients used in a technique for estimating surface runoff from rainstorms. Analyses of rainfall-runoff events for small watersheds (60 to 4200 acres) in Arizona, Colorado, Utah, and Wyoming show that the curve number decreases with increase in storm rainfall, approximating the runoff as a simple fraction of the

rainfall. This strongly suggests a constant 'impervious' runoff-source area, like channel interception, accompanied by high infiltration rates relative to storm intensity and a constant role for antecedent moisture (uniformly dry). However, extremes in storm intensity or watershed wetness may invoke other processes. (Singh-ISWS)
W80-04207

APPROXIMATE FLOOD ROUTING METHODS: A REVIEW,
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
P. E. Weinmann, and E. M. Laurenson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 105, No HY12, Proceedings Paper 15057, p 1521-1536, December 1979. 5 Fig, 1 Tab, 16 Ref, 2 Append.

Descriptors: *Flood routing, *Model studies, *Open channel flow, *Unsteady flow, Hydraulics, Hydrology, Analytical techniques, Numerical analysis, Rating curves, Hydraulic models, *Finite difference method, *Kinematic wave models, Dynamic effects.

Some well-known approximate flood routing models, including diffusion analogy models, kinematic wave models, and various extensions of the storage routing methods, were reviewed in the light of their theoretical background. A class of kinematic models was identified, and close relationships among many superficially diverse models were demonstrated. Limits of application for different groups of models were indicated, and some emphasis was placed on the analyses of parameter selection procedures. Attention was drawn to the kinematic model corrected for dynamic effects, a generalized model developed recently by Koussis. It covers the widest range of practical applications, excluding only cases where dynamic effects or downstream disturbances play a major role. Other features were reviewed which make the Koussis model an ideal framework for the development of generalized computer programs for approximate flood routing computations. (Singh-ISWS)
W80-04208

THE RIVER CONTINUUM CONCEPT,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
R. L. Vannote, G. W. Minshall, K. W. Cummins, J. R. Sedell, and C. E. Cushing.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 130-137, January 1980. 2 Fig, 38 Ref. NSF BMS75-07333, DEB78-11671.

Descriptors: *Rivers, *Ecosystems, *Geomorphology, *Biological communities, Biology, Biomass, Invertebrates, Aquatic microbiology, Streams, Streamflow, Environment, Aquatic environment, River continuum, Ecosystem stability, River zonation.

From headwaters to mouth, the physical variables within a river system present a continuous gradient of physical conditions. This gradient should elicit a series of responses within the constituent populations resulting in a continuum of biotic adjustments and consistent patterns of loading, transport, utilization, and storage of organic matter along the length of a river. Based on the energy equilibrium theory of fluvial geomorphologists, it was hypothesized that the structural and functional characteristics of stream communities are adapted to conform to the most probable position or mean state of the physical system. The authors reasoned that producer and consumer communities characteristic of a given river reach become established in harmony with the dynamic physical conditions of the channel. In natural stream systems, biological communities can be characterized as forming a temporal continuum of synchronized species replacements. This continuous replacement functions to distribute the utilization of energy inputs over time. Thus, the biological system moves towards a balance between a tendency for efficient use of energy inputs through resource partitioning (food, substrate, etc.) and an opposing tendency for a uniform rate of energy processing throughout the year. It was theorized that biological communities developed in natural streams assume processing strategies involving minimum energy loss. Downstream communities are fashioned to capitalize on upstream processing inefficiencies. Both the upstream inefficiency (leakage) and the downstream adjustments seem predictable. The authors proposed that this River Continuum Concept provides a framework for integrating predictable and observable biological features of lotic systems. Implications of the concept in the areas of structure, function, and stability of riverine ecosystems were discussed. (Sims-ISWS)
W80-04222

LEAF LITTER PROCESSING IN A REGULATED ROCKY MOUNTAIN STREAM,
Colorado State Univ., Fort Collins.
R. A. Short, and J. V. Ward.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 123-127, January 1980. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Leaves, *Streams, *River regulation, *Rocky Mountain Region, *Colorado River, Mountains, Rivers, Litter, Invertebrates, Temperature, Water temperature, Dams, Streamflow, Biology, *Leaf litter processing.

Processing of alder (Alnus tenuifolia) was investigated during autumn and winter to determine the influence of stream regulation on leaf litter processing. Study sites were the Colorado River below Granby Dam and the Fraser River, an unregulated tributary. Alder leaves (5-g units) were attached to bricks and placed in riffles. Leaching controls were retrieved after 48 h; thereafter five replicates were collected from each site after 17, 38, 52, and 66 d. There were significant differences (P less than 0.05) in processing rates between sites. The loss rate coefficient (k) was much higher (k = 0.0462) for leaves incubated in the regulated section of the Colorado River than for those in the unregulated tributary (k = 0.0235). The hypothesis that reductions in macroinvertebrate shredders would decrease processing rates of leaf litter in regulated streams was not supported by the results. The 'winter warm' thermal regime below the reservoir seemed to compensate for the virtual absence of shredder species apparently by enhanced microbial processing. (Sims-ISWS)
W80-04223

EFFECTIVE RAINFALL ESTIMATION,
Technical Univ. of Prague (Czechoslovakia). Dept. of Irrigation and Drainage.
For primary bibliographic entry see Field 2G.
W80-04231

CONSTANT-RAINFALL INFILTRATION,
Technical Univ. of Prague (Czechoslovakia). Soil Science Lab.
For primary bibliographic entry see Field 2G.
W80-04232

CHARACTERIZATION AND MODELS OF WATERSHED STORAGE,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. R. Rao, P. C. Tao, and C. Rukvichai.
Journal of Hydrology, Vol 45, No 3/4, p 253-277, February 1980. 15 Fig, 6 Tab, 18 Ref. DACW 27-74-C-0072.

Descriptors: *Watershed(Basins), *Rainfall-runoff relationships, *Kentucky, Soil moisture, Hydrology, Time series analysis, Statistical models, Temperature, Streamflow, Evapotranspiration, Precipitation(Atmospheric), Fourier analysis, *Watershed storage, Stochastic models.

Precipitation and runoff are usually the only variables considered in forecasting runoff from watersheds by stochastic models. However, the degree of saturation of watersheds strongly affects statistical characteristics of daily runoff. Watershed storage series, which indicate the degree of saturation of a watershed, were analyzed, and the results were presented. The data from four watersheds in the Green River basin in Kentucky were analyzed. After a discussion of characteristics of the basic data, the watershed storage series was computed and its spectrum, correlogram, and other characteristics were discussed. Stochastic models were developed for the watershed storage series, and their prediction capability was analyzed. Daily watershed storage is a highly correlated seasonal variable which can be forecast a few days ahead with great accuracy. The utility of the watershed storage series in forecasting runoff was briefly discussed. (Lee-ISWS)
W80-04233

MODELLING AND ANALYSIS OF DATA FROM CATCHMENT STUDIES OF LAND USE CHANGE,
National Research Advisory Council of New Zealand, Wellington.
For primary bibliographic entry see Field 2A.
W80-04254

NITRATE REMOVAL FROM STREAMS DRAINING EXPERIMENTAL CATCHMENTS,
Ministry of Works and Development, Hamilton (New Zealand). Hamilton Science Centre.
For primary bibliographic entry see Field 5B.
W80-04265

EFFECTS OF INCREASED LAND-USE UPON FRESHWATERS IN THE CENTRAL HIMALAYAS,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
S. M. Das.
Progress in Water Technology, Vol 11, No 6, p 195-208, 1979. 6 Tab, 2 Ref.

Descriptors: *Land use, *Runoff, *Floods, *Mountains, Effects, Sediments, Erosion, Rainfall, Monsoons, Water pollution, Lakes, Eutrophication, Crops, Vegetation, Roads, Road construction, Geology, Glaciers, Rivers, *India, *Himalaya Mountains.

More than 80% of the total 1500 mm/year rainfall in the Indian Central Himalayas occurs during the monsoon months of June to September, when high intensity rains and cloudbursts are common. There is excessive runoff due to diminishing forest cover, unguarded terrace fields, steep and barren slopes, and periodic seismic phenomena, causing serious erosion, loss of top soil, leaching of the meagre soil nutrients, and high floods. The runoff carries a heavy silt load that causes rapid siltation of dams, reservoirs, rivers, and lakes. Construction of new roads extending across the hills has also caused extensive deforestation and landslides which have greatly increased the already severe problems of siltation and floods. In addition, the lakes of the Central Himalayas are becoming eutrophic and highly polluted due to increased human settlement and poor sanitation. The recent high floods in the Gangotri-Bhagirathi-Alakhnanda-Ganga basin and in the Jamunetri-Jamuna basin, have been caused partially by excessive rainfall in August 1978, but mainly by the siltation of streams and rivers during the last century. Some immediate preventive and remedial measures against destructive floods in the Central Himalayas are presented. (Sims-ISWS)
W80-04312

QUANTITATIVE DETERMINATION OF THE SUBGLACIAL HYDROLOGY OF TWO ALPINE GLACIERS,
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W80-04338

SUBGLACIAL CONSTRUCTIONS AND INVESTIGATIONS AT BONDHUSBREEN, NORWAY,
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2C.
W80-04339

RAINFALL-RUNOFF DATA FROM SMALL WATERSHEDS IN COLORADO, OCTOBER 1974 THROUGH SEPTEMBER 1977,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04371

THE CALIFORNIA WATER ATLAS.
California Office of Planning and Research, Sacramento.
For primary bibliographic entry see Field 2A.
W80-04444

2F. Groundwater

APPLICATION OF RECENT RESULTS IN FUNCTIONAL ANALYSIS TO THE PROBLEM OF WATER TABLES,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Advances in Water Resources, Vol 2, No 4, p 185-190, December 1979. 7 Ref.

Descriptors: *Darcys law, *Water table, *Hydrodynamics, *Potential flow, *Theoretical analysis, Mathematics, Analysis, Continuity equation, Groundwater, Porous media, Interfaces, Singularities, Singular surfaces.

The traditional viewpoint in hydrology and soil physics purports that water tables appearing in porous media described by Darcy's law and the extended Darcy's law are not singular surfaces. Several particular solutions in which singularities occur were presented as counter-examples to the traditional viewpoint and as evidence supporting the new theory that water tables are generally singular surfaces. (Adams-ISWS)
W80-04214

THREE-DIMENSIONAL SEEPAGE THROUGH A HOMOGENEOUS DAM,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
J. Caffrey, and J. C. Bruch, Jr.
Advances in Water Resources, Vol 2, No 4, p 167-176, December 1979. 7 Fig, 11 Ref.

Descriptors: *Numerical analysis, *Finite element analysis, *Free surfaces, Porous media, Dams, Analysis, Water table, Seepage, Potential flow, *Three-dimensional flow, *Finite difference analysis, Stream functions.

Seepage flow through a homogeneous earth dam is a free surface flow phenomenon. Because of the shape of the dam, a two-dimensional analysis may not be appropriate and a three-dimensional analysis would be required. Such situations were investigated using the Baiocchi method and transformation. Algorithms using finite difference and finite element successive over-relaxation methods with projection were formulated. The solution to several example cases were presented with a discussion of the approach. (Adams-ISWS)
W80-04215

ORGANIC CONTAMINANT BEHAVIOR DURING GROUNDWATER RECHARGE,
Stanford Univ., CA.
For primary bibliographic entry see Field 5A.
W80-04219

KARSTIC SPRING RECESSION HYDROGRAPH AND WATER TEMPERATURE ANALYSIS: OYMAPINAR DAM PROJECT, TURKEY,
J. Karanjac, and A. Altug.
Journal of Hydrology, Vol 45, No 3/4, p 203-217, February 1980. 6 Fig, 6 Ref.

Descriptors: *Karst, *Springs, *Sinks, *Dams, *Leakage, Tracers, Fluorescent dye, Velocity, Groundwater movement, Transmissivity, Water temperature, Groundwater recharge, Recession curves, Hydrographs, Water circulation, Limestones, Base flow, Karst hydrology, Discharge(Water), Depth, Geologic control, *Turkey, Hydraulic regime.

Karstic springs downstream of the high Oymapinar Dam, Turkey, which is under construction, were a cause of concern for eventual leakage of the Oymapinar Reservoir. Springwater temperatures were evaluated to indicate the depth of circulation and, implicitly, the extent of karstification. The evaluation of the temperature record, coupled to the interpretation of the spring recession hydrograph, was used to formulate the hypotheses for the recharge areas of the springs, transmissivity of the system, size of the system, and hydraulic regime of the springs. (Visocky-ISWS)
W80-04234

DISPERSIVITY AND VELOCITY RELATIONSHIP FROM LABORATORY AND FIELD EXPERIMENTS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
D. Klotz, K-P. Seiler, H. Moser, and F. Neumaier.
Journal of Hydrology, Vol 45, No 3/4, p 169-184, February 1980. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Dispersion, *Velocity, *Laboratory tests, *On-site tests, Porous media, Hydraulics, Sediments, Sands, Gravels, Groundwater, Observation wells, *Dispersivity, Longitudinal dispersion, Grain-size distribution.

Laboratory test results on longitudinal dispersion of soluble material in loose rocks with artificially composed or natural grain-size distributions were compared with one another and with results of field tests. In this way it can be demonstrated that it is quite possible to translate laboratory results to field conditions, if sedimentological properties of the loose materials are comparable, if bedding (geological interfaces) runs parallel to the flow direction and is hydraulically ineffective, and if distances between injection and detection are about less than 50 m. Transverse dispersion is difficult to determine. At first approximation the width of tracer cloud from a line injection was determined and the aperture angle of the resultant cloud calculated. The laboratory and field experiments showed an aperture angle of about 5 degrees on distances between 10 and 2500 m. (Lee-ISWS)
W80-04235

ESTIMATION OF RECHARGE TO THE PHREATIC AQUIFERS OF THE LOWER MANER BASIN, INDIA, BY USING THE TRITIUM INJECTION METHOD,
National Geophysical Research Inst. Hyderabad (India).
R. N. Athavale, C. S. Murti, and R. Chand.
Journal of Hydrology, Vol 45, No 3/4, p 185-202, February 1980. 6 Fig, 6 Tab, 10 Ref.

Descriptors: *Groundwater recharge, *Water table aquifers, *Tracers, *Tritium, Aquifers, Groundwater, Monsoons, Sampling, Moisture content, Depth, Soil profiles, *India.

Recharge to the phreatic aquifers in seven different geological formations of Lower Maner Basin, Andhra Pradesh, which forms a part of the Godavari Rift Valley, has been measured by using the tritium tagging method. Twenty-eight sites, covering an area of approximately 1575 sq km, were selected on the basis of geology, topography, drainage pattern, and soil types of the basin. Tritium injections, at 70 cm depth, were made before the commencement of the monsoon rains in June 1976. Soil core samples, in 10-cm sections, were collected from the injection sites in December 1976, i.e., after completion of the monsoon rains. Variation in tritium activity and moisture content with depth, in each soil profile, was measured for estimation of tracer movement and calculation of recharge. The recharge values over Kota claystones and Pakhal shales were found to range from 7 to 12 cm, with an average value of 9.6 cm. In Kamthi sandstones, which also contain some shaly facies, the recharge was found to vary from 7 to 24 cm, with a mean value of 12.7 cm. The total annual input to groundwater reserves of the phreatic aquifers of the basin was estimated as 152,000,000 + or - 15,000,000 cu m. This amounts to approximately 8% of the average annual rainfall of 125 cm over the basin. (Visocky-ISWS)
W80-04249

GROUNDWATER TRANSPORT OF A SALT TRACER THROUGH A SANDY LAKEBED,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Biology and Health Physics Div.
For primary bibliographic entry see Field 2A.
W80-04250

AGRICULTURAL LAND USE AND ITS EFFECT ON CATCHMENT OUTPUT OF SALT AND WATER--EVIDENCE FROM SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
D. R. Williamson, and E. Bettenay.
Progress in Water Technology, Vol 11, No 6, p 463-480, 1979. 7 Fig, 4 Tab, 39 Ref.

Descriptors: *Land clearing, *Groundwater, *Recharge, *Salinity, *Australia, Salts, Runoff, Streamflow, Seepage, Water quality, Vegetation effects, Watersheds(Basins), Climates, Soils, Rainfall, Infiltration, Agriculture, Land use, Salt balance, Clearing effects.

Agricultural development over the past 200 years in southern Australia has involved extensive clearing of the native, evergreen vegetation and its replacement with annual rain-fed crops and pastures. These introduced plants have a limited growing season, are comparatively shallow rooted, and hence, in a Mediterranean climate, use less water. A consequence of this is the secondary salinization of about 277,000 ha of previously productive land and associated degradation of valuable water resources. These effects were first noted in the 1890s, and by 1924 it was hypothesized that increased recharge caused a rise in levels of saline underground water bringing salts to the soil surface particularly near water courses. Studies initiated in the 1960s have shown that large quantities of soluble salts are stored in the deep weathering zones characteristic of southern Australia. Under forested conditions, surface and near surface waters are relatively fresh, although deeper groundwaters may be highly saline. Data presented showed that groundwaters rise as a consequence of clearing. This leads to the development of saline seeps, which, together with an increase in saline baseflow, results in increased salt export from catchments. Although there is usually a concomitant increase in runoff, this may not be sufficient to keep annual stream salinity below an acceptable level. The pattern of changes in streamflow quality during the year was shown to provide an indicator of the contribution of saline baseflow to streams from small catchments. This may be useful in predicting the effect of clearing, or in indicating a decline in saline baseflow following re-afforestation. (Sims-ISWS)
W80-04259

THE EFFECTS OF LAND USE AND HYDROLOGY ON GROUNDWATER QUALITY IN MID-CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 5A.
W80-04261

THE EFFECTS OF IRRIGATION WITH MEATWORKS-FELLMONGERY EFFLUENT ON WATER QUALITY IN THE UNSATURATED ZONE AND SHALLOW AQUIFER,
Canterbury Frozen Meat Co. Ltd. Christchurch (New Zealand).
For primary bibliographic entry see Field 3C.
W80-04262

THE HYDROCHEMISTRY OF AN AQUIFER NETWORK,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Use Research.
For primary bibliographic entry see Field 2K.

W80-04263

NITRATE AND CHLORIDE IN GROUNDWATER, SURFACE WATER AND DEEP SOIL PROFILES OF CENTRAL CANTERBURY, NEW ZEALAND,
Lincoln Coll., (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5A.
W80-04264

EVAPORATION FROM VEGETATION IN LANDSCAPES DEVELOPING SECONDARY SALINITY USING THE VENTILATED-CHAMBER TECHNIQUE, II. EVAPORATION FROM ATRIPLEX PLANTATIONS OVER A SHALLOW SALINE WATER TABLE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2D.
W80-04273

MODEL APPLICATION TO URBAN GROUNDWATER PROBLEMS OF FAIRBANKS, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. L. Kane.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-166465, Price codes: A03 in paper copy, A01 in microfiche. Completion Report No 76-2, January 1980. 30 p, 7 Fig, 1 Tab, 20 Ref, 1 Append. OWRT B-033-ALAS(1).

Descriptors: *Alaska, *Groundwater recharge, *Frozen soils, *Permafrost, Frozen ground, Pumping, Model studies, Mathematical studies, Snowmelt, Precipitation(Atmospheric), Groundwater barriers, Groundwater movement, Tundra, Thawing.

The role of frozen soils in northern groundwater systems is examined and modeled. The combination of relatively dry climates, frozen soils, and increased use of groundwater is creating new stresses on the groundwater systems of northern areas such as Alaska where declining water levels are reported. To study the regional effects of pumping, a model was developed that uses the transient equation for liquid water transport in the soil. This water transport is created by hydraulic gradients in the soil. Two cases were simulated with the model, a single layered organic only case and a double layered organic and mineral case. Results of the model give an indication of the potential for recharge in a region. Factors accounted for in the model include: distribution of soil water, soil conditions, slope, and input rate. Results of the model application show that in the interior of Alaska the potential for groundwater recharge from precipitation is limited. This is due to both the pattern of precipitation and soil conditions. Prolonged rainfall or snowmelt is needed for significant recharge. Model results from a snowmelt show that frozen soil with a low moisture content of about 10% behaves much like dry unsaturated soil while very wet frozen soils are considered impermeable. Model equations and other results are given. (Seigler-IPA)
W80-04295

GROUNDWATER UTILIZATION, SOUTH FORK OF LONG ISLAND,
G. F. Pinder, and R. H. Page.
Clearwaters, Vol 9, No 4, p 11-14, December 1979. 7 Fig, 7 Ref.

Descriptors: *Mathematical models, *Aquifer characteristics, *Groundwater resources, Seepage, Groundwater movement, Water level fluctuations, Pumping, Infiltration, Saline water, Saline water-freshwater interfaces, Water levels, Water wells, Water supply development.

Two mathematical models developed to predict groundwater system responses to pumpage and development on the South Fork of Long Island are briefly described. The aquifer has a pillow of fresh water underlain by denser saline water. Fresh water flows outward toward the sea by coastal seepage and is replaced by natural recharge from precipitation and groundwater streams. Any changes in this balance of inflow and outflow such as a drought or pumpage results in a lower equilibrium thickness and could result in salt water being drawn up into wells depending on their location and depth. The models developed to study various pumpage situations use nonlinear partial differential equations solved numerically with finite elements. The regional model simulates variability in the two horizontal space dimensions, while the other model, the local model, studies pressures and concentrations near a well. The local model, which is used to predict the salinity of water from a particular well, is based on equations describing the density-dependent groundwater flow and the convective and dispersive transport of a solute. System inputs and parameters for the regional model, the hydrogeologic properties of the aquifer and inflow-outflow rates, were gathered in 1975-1976 and the model was calibrated to allow for errors in data. Data from a drought period in the 1960's were used for forecasting the impact of proposed withdrawals. Most of the pumpage options simulated were found to have acceptable regional impact. (Seigler-IPA)
W80-04302

HYDROLOGIC DATA FOR THE MORRIS BRIDGE WELL-FIELD AREA, HILLSBOROUGH COUNTY, FLORIDA, 1971-78,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr.
Available from: OFSS Bx 25425 Fed. Ctr. Denver, CO, paper copy $10.25 microfiche $3.50. Geological Survey open-file report 79-1262, 1979. 76 p, 9 Fig, 5 Tab, 8 Ref.

Descriptors: Hydrologic data, *Well data, *Florida, *Groundwater, *Data collections, Test wells, Aquifer characteristics, Monitoring, Networks, Streams, Hydrographs, Water levels, Streamflow, Rainfall observation wells, Water yield, Drawdown, *Hillsborough County(Fla).

Well data are summarized for 102 wells constructed in the Morris Bridge well-field area in north-central Hillsborough County. Of the wells reported, 20 are public-supply wells that have yields averaging 1,800 gallons per minute and specific capacities that range from 36 to 346 gallons per minute per foot of drawdown. Also presented are 28 drillers' logs, 7 lithologic logs, and an index of 64 geophysical logs of 18 wells in the well-field area. The report also includes hydrographs of water levels of 10 observation wells, hydrographs of stream stage and streamflow of the Hillsborough River, and hydrographs of rainfall for two stations. (Kosco-USGS)
W80-04372

WATER RESOURCES OF THE SANTA ROSA INDIAN RESERVATION AND VICINITY, RIVERSIDE COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-04376

RESULTS OF TRANSIENT SIMULATIONS OF A DIGITAL MODEL OF THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-04379

JANUARY 1979 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst.
Geological Survey open-file report 79-925, May 1979. 213 p, 3 Tab.

Descriptors: *Groundwater, *Water levels, *Observation wells, *Kansas, *Water level fluctuations, Irrigation, Seasonal, Groundwater recharge, Aquifers, Hydrogeology, Western Kansas, South-central Kansas.

Water-level measurements were made in about 1,300 observation wells in 35 counties as part of an annual inventory of ground-water conditions in western and south-central Kansas. The measurements were made in mid-winter, mostly in January 1979, when pumping was minimal and water levels had recovered from the effects of pumping during the previous irrigation season. Tables in this report show the depths to water in 1940, 1944, or 1950 (the predevelopment years), 1966 (a year of abnormally high rainfall), 1978 and 1979; water-level declines from 1940-79, or 1950-79, from 1966-79, 1974-79, or 1978-79; and average annual declines from 1940-79, 1944-79, or 1950-79 and from 1966-79. Also shown are saturated thicknesses of the deposits in 1940, 1944, or 1950 and in 1979, as well as the percentage change in saturated thickness from 1940-79, 1944-79, or 1950-79. (Kosco-USGS)
W80-04380

HYDROLOGIC AND GEOLOGIC DATA FROM THE UPPER EAST COAST PLANNING AREA, SOUTHEAST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. L. Miller.
Available from: OFSS Bx 25425, Fed. Ctr. Denver, CO 80225, Paper copy $13.25, Microfiche $3.50. Geological Survey open-file report 79-1543, 1979. 99 p, 2 Fig, 6 Tab.

Descriptors: *Hydrologic data, *Hydrogeology, *Water resources, *Planning, *Florida, Investigations, Well data, Aquifers, Lithologic logs, Water levels, Groundwater, Water quality, Water resources development, *Southeast Florida.

The Upper East Coast Planning Area, one of five designated planning areas in the South Florida Water Management District, consists of St. Lucie, Martin, and eastern Okeechobee Counties. Existing hydrologic and geologic data have been compiled as a base for additional investigations to determine the water-bearing characteristics of the shallow aquifer system in the area. These data include lithologic logs from 51 wells in excess of 90 feet in depth, periodic ground-water levels from 100 wells, and ground-water levels from 100 wells, and ground-water quality data from 93 wells. (Kosco-USGS)
W80-04381

HYDROGEOLOGIC FEATURES OF THE ALLUVIAL DEPOSITS IN THE NOWOOD RIVER DRAINAGE AREA, BIGHORN BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Cooley, and W. J. Head.
Geological Survey open-file report 79-1291 (WRI), 1979. 55 p, 4 Fig, 2 Plates, 11 Tab, 9 Ref.

Descriptors: *Groundwater resources, *Wyoming, *Aquifer characteristics, *Water yield, *Alluvium, Water wells, Alluvial aquifers, Hydrogeology, Surface-groundwater relationships, Rocky Mountain region, Streamflow, Groundwater recharge, Flood plains, Irrigation, Chemical analysis, Maps, *Bighorn Basin(Wyo), *Norwood River drainage area(Wyo).

In the Nowood River drainage area, Wyoming, the principal deposits comprising the alluvial aquifer include the flood-plain and younger (generally undissected) alluvial-fan deposits and a unique boulder-fan gravel. Other deposits mapped, but virtually nonwater yielding, are the older (dissected) alluvial-fan, pediment, and terrace deposits. Terraces are capped by gravel and form levels at 30-40, 45-100, 120-150, 200-260, and 280-330 feet above the Nowood River. The thickness of the alluvial aquifer indicated from the sparse well-log data and 42 surface resistivity measurements is between 25 and 50 feet along the Nowood River and more than 60 feet along Tensleep and Paint Rock

Creeks. The resistivity measurements indicate a buried bedrock ridge below the boulder-fan gravel between Paint Rock and Medicine Lodge Creeks and a buried channel filled by alluvium along Tensleep Creek. Well yields from the alluvial aquifer are estimated to be low. The most favorable areas for ground-water development are from the flood-plain alluvium along Tensleep Creek and from the boulder-fan gravel and adjoining flood-plain alluvium along Paint Rock and Medicine Creeks. Along the Nowood River the flood-plain alluvium, although its yields are small, has the best potential for ground-water development. (Kosco-USGS)
W80-04382

2G. Water In Soils

RUNOFF CURVE NUMBERS FROM PARTIAL AREA WATERSHEDS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W80-04207

EFFECTIVE RAINFALL ESTIMATION,
Technical Univ. of Prague (Czechoslovakia). Dept. of Irrigation and Drainage.
J. Mls.
Journal of Hydrology, Vol 45, No 3/4, p 305-311, February 1980. 3 Fig, 5 Ref.

Descriptors: *Precipitation excess, *Effective precipitation, *Runoff, Rainfall, Runoff coefficient, Runoff forecasting, Infiltration rates, Infiltration, Surface runoff, Hydrology, Soil moisture, Ponding, *Asymptotic infiltration rate, Water ponding, Time of ponding.

A method for estimating the rainfall effective in generating runoff was presented which is based on the infiltration process. With the use of the known equations that describe the ponding infiltration rate in time, a functional relationship between the cumulative infiltration and the maximum possible infiltration rate was stated. Based on that statement the equation of infiltration rate such as it occurs during a general rainfall, was derived, and the infiltration envelope curve was defined. The theory was applied to the evaluation of infiltration from rain of constant intensity, and the results were compared with the numerical analysis of Smith, offering a good agreement. The method was further used to determine the effective rainfall for a given rain of nonconstant intensity. (See also W73-04376) (Lee-ISWS)
W80-04231

CONSTANT-RAINFALL INFILTRATION,
Technical Univ. of Prague (Czechoslovakia). Soil Science Lab.
M. Kutilek.
Journal of Hydrology, Vol 45, No 3/4, p 289-303, February 1980. 7 Fig, 2 Tab, 23 Ref.

Descriptors: *Infiltration, *Runoff, *Infiltration rates, Runoff coefficient, Soil moisture, Ponding, Moisture content, Hydrology, Rainfall, *Ponding time, Moisture profile, Infiltration equation.

An approximate solution of the infiltration equation for rain of constant intensity was developed. From the theory, the ponding time and the development of the moisture profile at time shorter than ponding time were determined. Using the theoretical background, simple empirical and algebraic equations were derived for the calculation of the ponding time. The solutions were compared with the results of the numerical analysis; good agreement was found. The solution of the infiltration for time greater than ponding time was obtained either for 'delta function' soil or for an empirical infiltration equation. (Lee-ISWS)
W80-04232

ESTIMATION OF SOIL MOISTURE AT DEEPER DEPTH FROM SURFACE LAYER DATA,
Meteorological Office, Poona (India).
B. C. Biswas, and S. K. Dasgupta.
Mausam, Vol 30, No 4, p 511-516, October 1979. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Soil moisture, *Estimating, *Model studies, Mathematical models, Estimating equations, Soil water, On-site investigations, Soils, Soil types, Rainfall, Infiltration, Soil water movement, Agriculture, Regression analysis, Soil science, *India.

In situ measurements of soil moisture at deeper layers is very difficult especially in heavy soils. Regression equations have, therefore, been developed to estimate in the clear season soil moisture variations at deeper layers from fluctuation of soil moisture in the surface layer. Estimated values were compared with observed values. The estimates were reasonably accurate. (Sims-ISWS)
W80-04236

A STUDY ON WATER AVAILABILITY TO THE CROPS GROWN UNDER RAINFED CONDITIONS IN DIFFERENT SOILS AT BIJAPUR,
University of Agricultural Sciences, Bangalore (India).
B. V. Ramana Rao, B. R. Biradar, S. S. Surpur, M. Gopinatha Rao, and T. Satyanarayana.
Mausam, Vol 30, No 4, p 469-472, October 1979. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Soil water, *Soil moisture, *Evapotranspiration, Soils, Soil types, Crops, Rainfall, Water storage, Drainage, Evaporation, Agriculture, Meteorology, Climatology, Soil science, *India, Water availability.

The soil moisture available in the red sandy soils, red loams, medium black soils, and deep black soils at Bijapur was estimated using a simple climatic water balance model. As the ratio of actual evapotranspiration to the potential evapotranspiration gives the rate at which water is supplied compared to the demand for water, the values of the ratio A sub E/P sub E with 40, 60, and 80% probabilities in different soils were presented. The planting schedules for short, medium, and long duration crops were worked out, and the chances of sowing the crops of different durations during the optimum sowing periods were given. (Sims-ISWS)
W80-04239

THE EFFECTS OF IRRIGATION WITH MEATWORKS-FELLMONGERY EFFLUENT ON WATER QUALITY IN THE UNSATURATED ZONE AND SHALLOW AQUIFER,
Canterbury Frozen Meat Co. Ltd. Christchurch (New Zealand).
For primary bibliographic entry see Field 3C.
W80-04262

EVAPORATION FROM VEGETATION IN LANDSCAPES DEVELOPING SECONDARY SALINITY USING THE VENTILATED-CHAMBER TECHNIQUE, II. EVAPORATION FROM ATRIPLEX PLANTATIONS OVER A SHALLOW SALINE WATER TABLE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2D.
W80-04273

AUTOMATIC MEASUREMENT OF SOIL-WATER PRESSURE USING A CAPACITANCE MANOMETER,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
For primary bibliographic entry see Field 7B.
W80-04305

PHOSPHORUS IN A MODEL POND STUDY: I SEDIMENT SELECTION AND PREPARATION,
Science and Education Administration, Durant, OK. Water Quality Management Lab.
For primary bibliographic entry see Field 5C.
W80-04343

2H. Lakes

WATER MANAGEMENT, WATER QUALITY AND ENGINEERING GEOLOGY STUDY OF SELECTED OXBOW LAKES AS THEY MAY BE IMPACTED BY DREDGING -- PHASE II,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. A. Lohnes, R. W. Bachmann, and T. A. Austin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164692, Price codes: A06 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University Completion Report No ISWRRI-103, ISU-ERI-AMES-80085, October 1979. 106 p, 21 Fig, 16 Tab, 45 Ref. OWRT A-066-IA (1).

Descriptors: *Iowa, *Oxbow lakes, *Dredging, *Sedimentation, Lake morphology, Lake morphometry, Lake sediments, Geomorphology, Water quality, Perched water, Groundwater, Hydrogeology, Erosion, Hydrology, Pumping, Wells.

Seven oxbow lakes located on the Missouri River floodplain in Iowa were studied to determine their value and water quality characteristics and to evaluate alternate water management improvement programs. The lakes studied were Lake Quinnebaugh, a shallow marsh; Badger Lake with extensive areas of aquatic vegetation; DeSoto Bend, a man-made cutoff; Carter Lake; Lake Manawa; Brown's Lake; and Blue Lake. Brown's Lake, Blue Lake, Lake Manawa, and DeSoto Bend are used extensively for recreation and were intensively studied. Data were gathered on lake morphometry, history, sedimentation, hydrology, and water quality. Results show that since these lakes were first cut off in the 1800's they have decreased to about 40% of their original area. This decrease is mostly due to lower groundwater tables rather than the common belief that extensive sedimentation has occurred. The lakes are perched and low-permeability silt and clay sediments seal the bottom to retard outward flow although there is a general outward flow gradient for most of the lakes. If dredging is used as a management technique care must be taken to prevent the destruction of this seal. Supplemental pumpings of groundwater appear to be a feasible management technique but well location should be carefully selected. Specific recommendations are given for the various lakes. (Seigler-IPA)
W80-04203

EFFECT OF AGRICULTURE ON CEDAR LAKE WATER QUALITY,
Illinois State Water Survey, Urbana.
D. P. Roseboom, R. L. Evans, and T. E. Hill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164619, Price codes: A04 in paper copy, A01 in microfiche. ISWS Circular 138, 1979. 61 p, 42 Fig, 32 Tab, 79 Ref.

Descriptors: *Lakes, *Illinois, *Water quality, *Agricultural watersheds, *Water pollution sources, Aquatic environment, On-site investigations, Data collections, Limnology, Water pollution, Effects, Pesticides, Organic pesticides, DDT, Dieldrin, Lake sediments, Heavy metals, Water chemistry, Dissolved oxygen, Analysis, Algae, Benthos, Water temperature, Lead, Copper, Zinc, Iron, Mercury, Arsenic, Secchi disks, Alkalinity, Hardness(Water), Phosphorus, *Carbondale(IL), *Cedar Lake(IL).

This study was made to delineate the type, distribution, and magnitude of orchard-related pesticides in the aquatic environment of Cedar Lake which includes the older impoundments of Little Cedar Lake and the Alto Pass Reservoir. Cedar Lake is a source of water supply for Carbondale, Illinois. The study included analyses for mineral and pesticide content of the soils, the water and bottom muds of the three lakes, and the water and sediments of the four major tributaries. In addition, the general limnology and biological characteris-

tics of Cedar Lake were defined, sedimentation surveys of the two older lakes were performed, and relevant data regarding pesticide content in fish were evaluated. The results showed that application of pesticides in well-sodded orchards does not pose a serious threat to the water quality of Cedar Lake, but a threat does exist when such orchard lands are converted to row crops, subdivisions, or other uses that destroy the sod cover that minimizes soil erosion. Pesticide residues that make their way by soil movement to the aquatic environment do accumulate in the bottom muds of the lakes, and may become solubilized and thus transferred to the lake waters. The waters of Cedar Lake stratify in summer resulting in depletion of dissolved oxygen in the lower 15 feet of water. Lake management to minimize such oxygen depletion is needed to control taste and odors and the introduction of undesirable metals in the water supply. The sedimentation surveys showed that soil loss on the watershed is excessive and that soil erosion prevention procedures are needed. The desirable game fish in the lakes contain mercury concentrations in excess of FDA tolerance limits despite the fact that mercury in excess of background levels was not found in the soils, suspended sediment, nor lake bottom sediments in the watershed. Research as to possible effects of inundated vegetation on the transfer of mercury from water to fish is suggested. DDT and dieldrin in fish are not a cause for concern in the Cedar Lake watershed. (Humphreys-ISWS)
W80-04206

COUPLING OF INTERNAL WAVE MOTION WITH ENTRAINMENT AT THE DENSITY INTERFACE OF A TWO-LAYER LAKE,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
R. H. Spigel.
Journal of Physical Oceanography, Vol 10, No 1, p 144-155, January 1980. 3 Fig, 17 Ref.

Descriptors: *Lakes, *Waves(Water), *Internal waves, *Model studies, Mathematical models, Density, Winds, Stratification, Equations, Energy, Pressure, Stress, Velocity, Entrainment, Limnology.

A solution was presented to the problem of a two-layer rectangular basin subject to a suddenly applied, uniform wind stress; Coriolis effects were ignored. The solution was obtained for the case in which the time scales of internal wave motion, wave decay, and entrainment are widely separated; in this range the entrainment across the interface is a perturbation on the mean motions. The solution included an oscillatory initial response, followed by wave decay and a steady-state interface setup with baroclinic circulation, all superimposed on a slow deepening of the top layer by entrainment. The entrainment in turn affects the frequency of interfacial waves as the mixed layer deepens--the deepening alters top and bottom layer thickness and the density jump between them. For the range of mixed-layer Richardson number considered, entrainment is energized by wind stirring at the water surface, which does work at a rate proportional to (u*) cubed. (Sims-ISWS)
W80-04209

KINETICS OF RED CLAY BLUFF DISSOLUTION IN WESTERN LAKE SUPERIOR,
Wisconsin Univ.-Superior.
For primary bibliographic entry see Field 2J.
W80-04216

ESTIMATES OF LAKE ST. CLAIR EVAPORATION,
National Oceanic and Atmospheric Administration, Ann Arbor. MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D.
W80-04217

A SIMPLE REFLECTANCE METHOD FOR THE MEASUREMENT OF PARTICULATE PIGMENT IN LAKE WATER AND ITS APPLICATION TO PHOSPHORUS-CHLOROPHYLL-SESTON RELATIONSHIPS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. Bergmann, and R. H. Peters.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 111-114, January 1980. 3 Fig, 10 Ref.

Descriptors: *Phosphorus, *Chlorophyll, *Seston, *Lakes, Sampling, Analytical techniques, Pigments, Plant pigments, Light, Reflectance, Algae, Aquatic microorganisms, Filters, Membranes, Limnology.

This paper described a new method to measure total sestonic pigment based on the reduction in the amount of light reflected from a membrane filter after a given volume of lake water has passed through the filter. For a sample of 30 lakes, this index of 'reflectance' gave a better regression on total phosphorus than did chlorophyll which suggests that part of the variation in published phosphorus-chlorophyll relationships results from the association of phosphorus with pigments other than chlorophyll. But the residual variation suggested both that the amount of pigment developed per unit of phosphorus varies among lakes and that the index does not completely represent the seston. Relationships between reflectance and concentration of chlorophyll, phosphorus, and seston were good enough to suggest that this rapid, easy analysis may find application as an adjunct to more traditional analyses wherever membrane filters are routinely used in the analysis of lake water. (Sims-ISWS)
W80-04224

OXYGEN DEPLETION IN LAKE ERIE: HAS THERE BEEN ANY CHANGE,
Department of the Environment, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).
M. N. Charlton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 72-81, January 1980. 8 Fig, 1 Tab, 23 Ref.

Descriptors: *Oxygen, *Dissolved oxygen, *Hypolimnion, *Lake Erie, Temperature, Water temperature, Water levels, Climatology, Sampling, Data processing, Analytical techniques, Lakes, Eutrophication, Limnology, *Oxygen depletion rates.

A new analysis of hypolimnetic oxygen in central Lake Erie indicates that historic increases in the apparent depletion were not as great as formerly believed. The differences that did occur were mostly related to variations in hypolimnion thickness. Changes, if any, in the oxygen depletion rate due to eutrophication are as yet too small to be recognized. Present-day oxygen depletion rates, when corrected for the relatively high temperatures in Lake Erie, are within the range thought to be indicative of mesotrophy in small lakes. The general level of oxygen depletion observed in the central basin of Lake Erie is expected on the basis of morphology alone. (Sims-ISWS)
W80-04225

DYNAMICS OF DISSOLVED OXYGEN DURING ALGAL BLOOM IN LAKE KASUMIGAURA, JAPAN,
Tsukuba Univ., Ikaraki (Japan). Inst. of Biological Sciences.
H. Seki, M. Takahashi, Y. Hara, and S. Ichimura.
Water Research, Vol 14, No 2, p 179-183, 1980. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Dissolved oxygen, *Algae, *Lakes, Nutrients, Solar radiation, Water temperature, Light, Phytoplankton, Chlorophyll, Bacteria, Nitrogen, Nitrogen compounds, Phosphorus, Oxygen, Water quality, Sampling, Limnology, Analytical techniques, Data processing. *Lake Kasumigaura(Japan).

Dynamics of dissolved oxygen during an algal bloom were studied in Lake Kasumigaura. Great amounts of oxygen arose from photosynthesis, and the concentration of dissolved oxygen reached 190% of saturation at 12 h. The majority of the dissolved oxygen produced was liberated into the atmosphere or consumed by microorganisms. Only minor fractions were transported into the dysphotic zone due to the low eddy diffusion coefficient in deeper waters of the euphotic zone. (Sims-ISWS)
W80-04242

EFFECTS OF RURAL AND URBAN SOURCES OF PHOSPHORUS OF LAKE BURLEY GRIFFIN,
Canberra Coll. of Advanced Education (Australia). School of Applied Science.
For primary bibliographic entry see Field 5B.
W80-04270

DESCRIPTIVE AND COMPARATIVE STUDIES OF MAINE LAKES,
Maine Univ. at Orono. Life Sciences and Agriculture Experiment Station.
R. B. Davis, J. H. Bailey, M. Scott, G. Hunt, and S. A. Norton.
University of Maine Life Sciences and Agriculture Experiment Station. Technical Bulletin No 88, March 1978. 337 p, 68 Fig, 33 Tab, 117 Ref, 5 Append.

Descriptors: *Lakes, *Maine, *Basic data collections, *Chemical properties, *Biological properties, Water chemistry, Water pollution sources, Trophic level, Oligotrophy, Phosphorus, Nitrogen, Phytoplankton, Zooplankton, Water pollution, Watersheds(Basins), Land use, Alkalinity, Chlorophyll, Coliforms.

Maine has 5,700 lakes greater than 0.4 ha in area; this descriptive and comparative study focused on 17 Maine lakes (22 basins). Lakes were sampled June 1970-May 1973. Watersheds are usually heavily forested (50-97%), but in southwestern Maine agricultural lands comprise significant percentages of the watersheds. Major point pollution sources exist at Haley Pond and Long Lake; otherwise, pollutants originate at shoreline cottages or from agricultural fields. Severe cultural eutrophication exists only in a few Maine lakes. Mean alkalinities range 4-27 ppm CaCO3, typical of oligotrophic-oligomesotrophic lakes. Mean total phosphorus ranges 2.4-27.8 ppb; phosphate concentrations range 0.2-4.0 ppb in surface waters. Mean inorganic fixed nitrogen ranges 32-190 ppb and averages 96 ppb. Mean phytoplankton cell counts range 140-30,700/ml; blue-green algae are most numerous and diatoms most voluminous. Mean sestonic chlorophyll-a values range 0.8-4.3 microg/l. The most numerous zooplankters are rotifers, especially Conochilus, Keratella and Kellicottia; mean values range 10-179 zooplankters/l. Mean Secchi disc transparency ranges 2.6-9.4 m. Maine lakes have an average of 11.9 cottages per km of shoreline. Lake water contamination by coliform bacteria occurs at numerous locations associated with cottages. Suitability of shoreline soils for septic disposal is poor or very poor at most locations. Open water mean counts are 4-7 FC/100 ml, unsuitable for drinking water purposes. (Danovich-Wisconsin)
W80-04286

ROLE OF SEDIMENTATION IN THE PHOSPHORUS BUDGET OF NATURAL AND ARTIFICIAL IOWA LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
R. W. Bachmann, and D. E. Canfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-166507, Price codes: A05 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University Completion Report No ISU-ERI-AMES-80030, September 1979. 101 p, 7 Fig, 11 Tab, 56 Ref. OWRT A-063-IA(1).

Descriptors: *Iowa, *Sedimentation rates, *Phosphorus, *Cycling nutrients, Lake stages, Mathematical models, Eutrophication, Limnology, Nutrients, Trophic level, Bottom sediments, Lake sediments, Chlorophyll, Secchi disks.

The limnological factors that influence sedimentation rates in natural and artificial lakes were studied and an empirical phosphorus model to predict

lake total phosphorus concentrations was developed and tested. Sediment traps were used to measure phosphorus sedimentation rates in four natural and four artificial Iowa lakes. While the sedimentation rates were found to be highly variable they were found to directly and significantly correlate with mean inorganic suspended matter concentrations and inorganic sedimentation rates. The rates measured in the Iowa lakes indicated that the lakes were losing from 5% to 60% of their total phosphorus daily. Since these lakes were not rapidly depleted of phosphorus as these rates would indicate it is probable that resuspension and resedimentation caused the traps to overestimate the net accumulation. Nutrient budget data from 290 natural and 433 artificial lakes in the U.S., Canada, and Europe, were used as a data base for a simple empirical phosphorus loading model that is based on the Vollenweider equation for input and output of phosphorus in lakes. The model was tested and found to predict lake total phosphorus concentrations equally well in both natural and artificial lakes. The model produces unbiased estimates of total phosphorus concentrations and has a 95% confidence interval of 31% to 288%. Due to the influence of allochthonous particulates in artificial lakes the model estimates for artificial lakes are less reliable. (Seigler-IPA)
W80-04294

FALLOUT PLUTONIUM IN AN ALKALINE, SALINE LAKE,
Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, R. M. Trier, C. R. Olsen, D. E. Hammond, and A. Ege.
Science, Vol 207, No 4435, p 1071-1073, March 7, 1980. 2 Tab, 29 Ref. DOE EY2529.

Descriptors: *Fallout, *Radioisotopes, *Lakes, *Saline lakes, Salinity, Alkalinity, Sediments, Freshwater, Chemicals, Water chemistry, Water pollution, Sampling, Pollutants, Chemical analysis, Limnology, *Mono Lake(CA), Plutonium.

Plutonium isotopes, derived from global fallout following atmospheric testing of nuclear weapons, were measured in the water and sediments of a natural alkaline, saline lake. The activities of fallout plutonium in the water column were about two orders of magnitude greater than in most freshwater lakes, where these nuclides are found predominantly in the sediments. (Sims-ISWS)
W80-04306

EFFECTS OF INCREASED LAND-USE UPON FRESHWATERS IN THE CENTRAL HIMALAYAS,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
For primary bibliographic entry see Field 2E.
W80-04312

BIOLOGICAL OBSERVATIONS ON THE CRATER LAKES OF JEBEL MARRA, SUDAN,
Westfield Coll., London (England). Dept. of Zoology.
J. Green, A. I. El Moghraby, and O. M. M. Ali.
Journal of Zoology, Vol 189, No 4, p 493-502, December 1979. 6 Fig, 18 Ref.

Descriptors: *Craters, *Lakes, *Jebel Marra(Sudan), *Biological communities, *Salinity, *Oxygen sag, Ecological distribution, Ecotypes, Niches, Eutrophication, Phytoplankton, Zooplankton, Water temperature, Hydrogen ion concentration, Diatoms, Rotifers, Aquatic insects, Volcanoes, Africa, Mixing, Stratification, Winds.

Floral and faunal compositions in two crater lakes on the top of Jebel Marra, western Sudan, were studied in January 1976; differences in fauna observed between these two lakes is attributed to different salinity and oxygen regimes. Small Dariba Lake is shallow (11.5 m) and highly saline with even temperatures throughout the lake. Large Dariba Lake (108 m) is less saline and periodically exhibits temperature stratification. In the shallow lake oxygen is supersaturated in the upper 2 m but no oxygen occurs below 6 m except when strong winds mix the lake, creating 40% oxygen saturation throughout the water column. In the deep lake after strong winds, there is 12% saturation in the top 30 m. In both lakes pH fluctuates between 9.0-10.0. Phytoplankton in Large Dariba Lake consist of Spirulina geitleri and Anabaenopsis arnoldii. Diatoms (Melosira and Nitzchia) are the only phytoplankton present in Small Dariba Lake. Zooplankton Brachionus plicatilis, B. dimidiatus and Hexarthra jenkinae occur in both lakes. Individuals from nine insect orders are found in the smaller lake. A laviform aquatic lampyrid, or glow-worm, is also recorded in the small lake; this is the first account of an aquatic glow-worm in Africa. Poor faunas of these lakes are attributed to: isolation of the volcanic massif in an arid area, lake salinity, and unfavorable oxygen regimes. (Harris-Wisconsin)
W80-04350

A STATISTICAL MODEL FOR SMALL LAKE WATER QUALITY MANAGEMENT,
De Paul Univ., Chicago, IL.
For primary bibliographic entry see Field 5C.
W80-04359

LAKE MACROPHYTES AS THE FOOD OF ROACH (RUTILUS RUTILUS L.) AND RUDD (SCARDINIUS ERYTHROPHTHALMUS L.) I. SPECIES COMPOSITION AND DOMINANCE RELATIONS IN THE LAKE AND FOOD,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W80-04364

MONTHLY AND ANNUAL WATER BUDGETS OF LAKE WINGRA, MADISON, WISCONSIN, 1972-77,
Geological Survey, Madison, WI. Water Resources Div.
R. P. Novitzki, and B. K. Holmstrom.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-149842, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 79-100, November 1979. 31 p, 6 Fig, 9 Tab, 16 Ref.

Descriptors: *Hydrologic budget, *Lakes, *Wisconsin, *Wetlands, *Lake stages, Water quality, Precipitation(Atmospheric), Inflow, Discharge(Water), Evapotranspiration, Data collections, Lake Wingra(Wis).

This report presents estimated annual and monthly water budgets for Lake Wingra in Wisconsin and the adjacent wetland area for January 1972 through September 1977. Annually, inputs from precipitation, surface runoff, and ground-water inflow are approximately equal (31, 34, and 35 percent, respectively). Outputs include outflow from the lake into Murphy Creek (70 percent), evapotranspiration from the lake and wetland (26 percent) and ground-water outflow (4 percent). The inputs and outputs vary seasonally. In months when snowmelt occurs, surface runoff is a major input (56 percent in March; 46 percent in April). In fall and winter ground-water inflow is a major input (57 percent in November). Precipitation is 41 percent of the inflow in August, but only 18 percent in January. Lake outflow is the major output except in July, August, and September. Combined evaporation and evapotranspiration is a major output in summer (45 to 58 percent) but minor in winter (less than 13 percent). Ground-water outflow is a small part of the budget each month, ranging from 2 percent in March and April to a maximum of 7 percent in September. (Kosco-USGS)
W80-04369

STUDIES ON THE USEFULNESS OF DIFFERENT MESH-SIZE PLANKTON NETS FOR THICKENING ZOOPLANKTON,
Polish Academy of Sciences, Warsaw. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W80-04445

DIATOM ASSOCIATIONS AND SUCCESSION IN LAKE KARIBA, SOUTH CENTRAL AFRICA,
University of the Witwatersand, Johannesburg (South Africa).
For primary bibliographic entry see Field 5C.
W80-04455

A COMPENDIUM OF LAKE AND RESERVOIR DATA COLLECTED BY THE NATIONAL EUTROPHICATION SURVEY IN EASTERN NORTH-CENTRAL, AND SOUTHEASTERN UNITED STATES.
National Eutrophication Survey, Corvallis, OR.
For primary bibliographic entry see Field 5C.
W80-04458

2I. Water In Plants

PLANT PATHOGENS AS AGENTS FOR BIOLOGICAL AND INTEGRATED CONTROL OF AQUATIC PLANTS,
Wisconsin Univ.-Madison. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5B.
W80-04290

AMMONIUM UPTAKE BY SYMBIOTIC AND APOSYMBIOTIC REEF CORALS,
California Univ., Los Angeles. Dept. of Biology.
L. Muscatine, H. Masuda, and R. Burnap.
Bulletin of Marine Science, Vol 29, No 4, p 572-575, October 1979. 2 Fig, 13 Ref. NSF GB 41458.

Descriptors: *Algae, *Ammonium compounds, *Symbiosis, *Kinetics, *Reefs, Ammonium salts, Madracis mirabilis, Ammonia, Laboratory tests, Nutrients, Ecology, Coral, Nutrient requirements, Discovery Bay, Jamaica, Sea water.

Laboratory experiments of ammonium uptake by symbiotic and aposymbiotic Madracis mirabilis (coral reef) colonies show that uptake is affected by symbiotic algae (zooxanthellae). With symbiotic M. mirabilis, ammonium medium concentration decreases rapidly during the first 10-15 minutes and relatively more slowly thereafter, approaching ambient concentrations after 2-3 hr. Aposymbiotic M. mirabilis and spiked sea water controls also decrease the ammonium concentration, both at virtually identical rates, but at 1/6th the rate of synbiotic M. mirabilis. Faster uptake by isolated algae than by controls; however, uptake rates by isolated algae are also significantly lower than those for intact corals based on zooxanthellae numbers. Naturally-occurring aposymbiotic colonies of M. mirabilis were located in Discovery Bay, Jamaica, contiguous with larger colonies of normal synbiotic M. mirabilis coral. (Danovich-Wisconsin)
W80-04340

EFFECTIVENESS OF SUBMERSED ANGIOSPERM-EPIPHYTE COMPLEXES ON EXCHANGE OF NUTRIENTS AND ORGANIC CARBON IN LITTORAL SYSTEMS. III. REFRACTORY ORGANIC CARBON,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 5B.
W80-04348

GROWTH OF THE AQUATIC PLANT MYRIOPHYLLUM SPICATUM IN A LITTORAL AREA OF THE HUDSON RIVER ESTUARY,
EG and G Environmental Consultants, Waltham, MA.
C. A. Menzie.
Aquatic Botany, Vol 6, No 4, p 365-375, August 1979. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Myriophyllum spicatum, *Hudson River Estuary(NY), *Standing crops, *Seasonal, *Growth rates, Estuaries, Aquatic plants, Leaves, Biomass, Haverstraw Bay(NY), Algae, Ecology, Organic matter, Water temperature, Variability, Biological communities, Physical properties, Sediments, Substrates, New York.

Eurasian milfoil (Myriophyllum spicatum) standing crops range from 0 g/sq m in winter to 60 g/sq m in summer in a cove within Bowline Pond, a small embayment of the Hudson River, New York measured January 1975-1976. M. spicatum main growth occurs May-December; peaks in dry weight biomass are observed in July (60 g/sq m) and October (32 g/sq m). Biomass decreases abruptly in August due to high temperatures (42C). Loss of plant biomass November-January represents winter die-off. Therefore, cove standing stocks exhibit major temporal variability. Low maximum standing crop (60 g/sq m) is due to physical conditions in the estuary; primary factors are probably light penetration (less than 1 m), tidal current regime (velocities up to 30 cm/s), and sediment type (sandy). M. spicatum annual productivity is 82 g/sq m. The proportion of leaf and stem biomass shifts throughout the year. Relative proportion of leaf biomass decreases May-July, corresponding to early M. spicatum growth. Following standing stock peak, the relative proportion of leaf biomass increases. Particulate matter on M. spicatum ranges from 0.8 g/g M. spicatum biomass (June mean) to 3.8 g/g M. spicatum (May mean). Particulate matter dry weight is generally greater than M. spicatum biomass; annual accumulation rate is 118 g/sq m. Large amounts of accumulated particulate matter in May are due to filamentous diatom Melosira. From June to August, Cladophora fracta, a filamentous green algae, comprises most of this material. (Danovich-Wisconsin)
W80-04349

INORGANIC MINERAL NUTRIENT LEVEL STUDIES ON POTAMOGETON PECTINATUS L. AND ENTEROMORPHA PROLIFERA IN FORFAR LOCH, SCOTLAND,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W80-04356

PHOSPHATE REQUIREMENT OF ANABAENA OSCILLARIOIDES AND ITS ECOLOGICAL IMPLICATIONS,
Auckland Univ. (New Zealand). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W80-04454

FACTORS CAUSING ELEVATED BIOLOGICAL OXYGEN DEMAND IN THE LITTORAL ZONE OF LAKE WINGRA, WISCONSIN,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W80-04457

2J. Erosion and Sedimentation

CALCULATION OF THE TOTAL ANTHROPOGENIC LEAD IN THE SEDIMENTS OF A RURAL ONTARIO LAKE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W80-04210

KINETICS OF RED CLAY BLUFF DISSOLUTION IN WESTERN LAKE SUPERIOR,
Wisconsin Univ.-Superior.
D. A. Bahnick, T. P. Markee, and R. K. Roubal.
Journal of Great Lakes Research, Vol 5, No 2, p 221-224, 1979. 1 Fig, 12 Ref. EPA R005169-01.

Descriptors: *Erosion, *Bank erosion, *Silica, *Lake Superior, Dissolved solids, Clays, Particle size, Mineralogy, Sediments, Solutes, Chemicals, Lakes, Dissolution, Clay bluffs.

The dissolution of red clay bluff samples from the southwestern Lake Superior shoreline area in Lake Superior water or deionized water was studied by following the aqueous concentrations of reactive silica over a 3-month period. The dissolution process was initially rapid, followed by a first-order dissolution process (k = 9.4 x 10 to the minus 7th power/sec) up to about 30 days. After about 30 days, the rate of dissolution of the bluff material followed linear kinetics (k = 5.4 x 10 to the minus 8th power mg Si02/gram of bluff per second). (Sims-ISWS)
W80-04216

MINERALOGY AND DISTRIBUTION OF FINE-GRAINED SEDIMENTS IN LITTLE TRAVERSE BAY, LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
D. K. Rea, and J. D. Pigula.
Journal of Great Lakes Research, Vol 5, No 2, p 170-176, 1979. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Sediments, *Mineralogy, *Distribution patterns, *Bays, *Lake Michigan, Bottom sediments, Sediment transport, Particle size, Water circulation, Winds, Sampling, Data processing, Analysis, Quartz, Carbonates, Clays, Sedimentology, *Little Traverse Bay(MI), Feldspar.

Little Traverse Bay, northeastern Lake Michigan, contains sediments ranging in mean grain size from about 1.5 phi around the bay margins to 7 phi in the central portion. Mineralogy of the fine-grained fraction of these sediments show the four main mineral groups, quartz, feldspars, clays, and carbonates, to have decidedly different distributions within the bay. Quartz and feldspar reach maxima near the center of the bay, while carbonates are highest around the edge. Clay mineral abundance reaches three separate maxima in regions characterized by very poorly sorted sediment. There are two important sources of these sediments, extensive outcrops of Devonian limestones and dolomites along the south shore of the bay and bluffs of reddish glacial till along the northwestern shoreline. Materials from these areas are transported eastward to the bay head by longshore transport incurred by the prevailing westerly winds and then return westward along the deep central trough of the bay as the wind-induced setup is relieved. Essentially all the calcite and much of the dolomite entering Little Traverse Bay undergoes dissolution during transport resulting in the carbonate-poor sediments of the bay floor. (Sims-ISWS)
W80-04218

THE TRANSPORT AND OXYGEN DEMAND OF ORGANIC CARBON RELEASED TO RUNOFF FROM CROP RESIDUES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5B.
W80-04226

AVAILABILITY TO SCENEDESMUS QUADRICAUDA OF DIFFERENT FORMS OF PHOSPHORUS IN SEDIMENTARY MATERIALS FROM THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W80-04253

AGRICULTURAL SOURCES OF FLUVIAL SUSPENDED SEDIMENTS,
Guelph Univ. (Ontario). Ontario Inst. of Pedology.
G. J. Wall, W. T. Dickinson, and L. J. P. van Vliet.
Progress in Water Technology, Vol 11, No 6, p 481-499, 1979. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Erosion, *Sediments, *Sediment transport, *Agricultural-runoff, *Canada, Variability, Spatial distribution, Temporal distribution, Watersheds(Basins), Soils, Suspended solids, Dissolved solids, Precipitation(Atmospheric), Rainfall, Snowmelt, Mapping, Sedimentology.

A detailed study regarding areas that contribute sediment into the streams of two small agricultural watersheds in Canada has revealed that these areas may be expected to (1) constitute a relatively small percentage of the total watershed area, (2) be highly variable from season to season, year to year, and basin to basin, and (3) be in close proximity to streams. The sediment-contributing area during high basin moisture spring conditions is essentially equivalent to the runoff-contributing area. Areas contributing runoff during low moisture conditions in the spring and fall are considered to be potential rather than active sediment-producing areas. High sediment-producing areas are located close to stream channels, but the distribution and significance of sediment-producing categories and their location varies from basin to basin. Management strategies for controlling sediment production in agricultural areas should therefore be closely linked to a consideration of sediment source areas and their variability in time and space. (Sims-ISWS)
W80-04258

SOME BASIC CONCEPTS OF WAVE SEDIMENT TRANSPORT,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
P. Nielsen.
Series Paper No 20, 1979. 160 p, 61 Fig, 3 Tab, 99 Ref, 1 Append.

Descriptors: *Sediment transport, *Reviews, *Model studies, *Boundary processes, *Beds, Waves(Water), Analytical techniques, Sediment-water interfaces, Suspended solids, Sediments, Shape, Beds under water, Movement, Theoretical analysis, Mathematical models, Flow, Drag, Bed load, Suspension, Ripple marks, Oscillatory flow, Incipient motion.

The literature on the basic mechanisms of wave sediment transport was reviewed. New theoretical and empirical results were presented concerning the motion of suspended particles, the magnitude and distribution of suspended sediment concentrations, and the geometry of bed forms under waves. A predictive model for sediment transport under waves and weak currents was presented. An analysis of the model revealed that the weakest point of our present-day knowledge on wave sediment transport is the description of the steady flow components near the bottom. Experimental results obtained during the study were listed in the appendix. (Humphreys-ISWS)
W80-04304

ENERGY DISSIPATION DURING SUBGLACIAL ABRASION AT NISQUALLY GLACIER, WASHINGTON, U.S.A.,
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 2C.
W80-04329

SEDIMENT CONCENTRATION IN MELT WATERS AS AN INDICATOR OF EROSION PROCESSES BENEATH AN ALPINE GLACIER,
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W80-04330

2K. Chemical Processes

ACID PRECIPITATION IN THE WESTERN UNITED STATES,
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr., and M. C. Grant.
Science, Vol 207, No 4427, p 176-177, January 11, 1980. 1 Fig, 11 Ref.

Descriptors: *Chemistry of precipitation, *Precipitation(Atmospheric), *Acidity, *Colorado, Sampling, Chemical analysis, Acids, Hydrogen ion concentration, Data processing, Water pollution, Water pollution sources, Air pollution, Path of pollutants, *Western U.S., *Acid precipitation, Trends.

Precipitation chemistry data from a rural area at an elevation of 2900 meters near the Continental Divide in Colorado showed unexpectedly low pH values for bulk precipitation. A significant downward trend in pH over the past 3 years is associated with increasing amounts of nitric acid in precipitation. (Sims-ISWS)

W80-04213

TRACE ELEMENTS IN MONSOON RAINS AT BOMBAY AND OVER THE ARABIAN SEA,
Bhabha Atomic Research Centre, Bombay (India).
S. Sadasivan.
Mausam, Vol 30, No 4, p 449-456, October 1979. 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Rain water, *Trace elements, *Monsoons, Rainfall, Chemicals, Chemistry of precipitation, Precipitation(Atmospheric), Water chemistry, Pollutants, Sea water, Sodium, Chlorine, Bromine, Iodine, Manganese, Calcium, Magnesium, Potassium, Sampling, Data processing, Regression analysis, *India.

A large number of rainwater samples were collected at three locations in Bombay city and were analyzed for sodium, chlorine, bromine, iodine, manganese, calcium, magnesium, and potassium. A few rainwater samples were also collected on board a ship, over the Arabian Sea, and were analyzed. The results showed that the seasalt aerosols predominate the trace element composition of the rainwater. Effect of industrial pollution was localized. The average Cl/Na ratio for all samples was near the seawater ratio of 1.8 while Br and I showed, respectively, a small and a very large enrichment relative to Na from seawater. The results indicated that K is enriched in the transfer from seawater to air while Mg is not. Large Ca excesses were measured in the samples, and a need for a correct evaluation of the source of this excess Ca was indicated. (Sims-ISWS)
W80-04240

THE CHEMISTRY OF THE RIVER WYE,
University of Wales. Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W80-04248

BUFFERING OF SILICA AND PHOSPHATE IN A TURBID RIVER,
Maine Univ. at Orono, Walpole. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W80-04252

THE HYDROCHEMISTRY OF AN AQUIFER NETWORK,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Use Research.
B. G. Williams, and R. Evans.
Progress in Water Technology, Vol 11, No 6, p 361-367, 1979. 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Water chemistry, *Groundwater, *Aquifers, *Australia, Geology, Hydrogeology, Sampling, Chemical analysis, Chemicals, Hydrogen ion concentration, Data processing, Analytical techniques, Classification, Watersheds(Basins), Hydrology, Chemistry.

A comparison was made between the interpretation of hydrochemical data from a network of shallow aquifers by conventional trilinear diagrams and a numerical classification technique. Neither method produced groupings that matched the nature and physical location of aquifers within the network, but Principal Coordinate Analysis appeared to have considerable potential for developing useful interpretations of subsurface water chemistry. (Sims-ISWS)
W80-04263

PHOSPHORUS IN A MODEL POND STUDY: I SEDIMENT SELECTION AND PREPARATION,
Science and Education Administration, Durant, OK. Water Quality Management Lab.
For primary bibliographic entry see Field 5C.
W80-04343

OCCURRENCE OF NITRIC AND NITROUS OXIDES IN A COASTAL MARINE SEDIMENT,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
J. Sorensen.
Applied and Environmental Microbiology, Vol 36, No 6, p 809-813, December 1978. 3 Fig, 18 Ref.

Descriptors: *Sediments, *Nitrogen cycle, *Denitrification, *Gases, *Cores, *Bacteria, Soil chemistry, Geochemistry, Nitrogen, Nitrogen compounds, Nitrites, Nitrates, Soil microorganisms, Depth, Aquatic animals, Burrows, Kysing Fjord(Denmark), Marine geology, Coasts, Oxidation-reduction potential, Reduction(Chemical), Denmark.

Chemical analysis suggests that bacterial denitrification is the source of nitric and nitrous oxides in sediment samples taken from Kysing Fjord, a shallow, brackish basin off Jutland, Denmark. Peak denitrification activity occurs 1-3 cm below the sediment surface and only a little activity occurs at low nitrate concentrations in the transition zone. Nitric and nitrous oxide accumulations are not associated with the main zone of denitrification activity; instead, the maximum is located at the lower edge of the activity profile. A secondary denitrification zone occurs in the deeper layers of cores which contain brown, oxidized patches in the black, sulfide-rich layers below the transition zone; these patches are apparently induced by macrofauna burrowing activity. Most cores contain sediment that is oxidized to 5 cm depth as judged from brown coloration and surface layer positive redox potentials. The transition zone towards deeper, reduced layers with negative redox potentials is usually 1-2 cm. Nitrate concentrations decline rapidly with depth, from maximum close to the sediment surface to low values at the transition zone. Nitric and nitrous oxide maxima are located at the transition zone. Nitrous oxide peak concentrations are always less than 5 micro M, whereas nitric oxide highest concentrations are 200 micro M. (Danovich-Wisconsin)
W80-04362

2L. Estuaries

NUTRIENT AND OXYGEN REDISTRIBUTION DURING A SPRING NEAP TIDAL CYCLE IN A TEMPERATURE ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point; and College of William and Mary, Gloucester Point, VA. School of Marine Science.
K. L. Webb, and C. F. D'Elia.
Science, Vol 207, No 4434, p 983-985, February 29, 1980. 2 Fig, 1 Tab, 16 Ref. NSF OCE75-2041.

Descriptors: *Estuaries, *Nutrients, *Dissolved oxygen, *Tidal effects, Oxygen, Density, Nitrogen compounds, Nitrites, Ammonia, Phosphorus, Phosphorus compounds, Phosphates, Stratification, Water circulation, Tides, Tidal waters, Sampling, Data processing, Nitrogen.

Spring tidal currents produce homogeneous water columns in a number of estuaries that are moderately stratified during neap tides. In the York River estuary, this destratification redistributes ammonium and phosphate regenerated by the benthos as well as oxygen from the surface. This redistribution has significant implications for nutrient cycles, organism distributions, and the management of estuaries. (Sims-ISWS)
W80-04212

EFFECTS OF CONTINUOUS CHLORINATION ON ENTRAINED ESTUARINE PLANKTON,
Environmental Protection Agency, Johns Island, SC.
S. J. Erickson, and H. R. Foulk.
Journal of the Water Pollution Control Federation, Vol 52, No 1, p 44-47, January 1980. 1 Tab, 13 Ref.

Descriptors: *Chlorination, *Estuaries, *Plankton, Sea water, Chlorine, Effects, Water temperature, Salinity, Biomass, Algae, Laboratory tests, Phosphates, Analytical techniques, Chlorination effects, Adenosine triphosphate.

The effects of continuous chlorination on planktonic life as measured by adenosine triphosphate content were examined in two running seawater aquaria systems for 1 year. The first system had ninety-six 37-liter aquaria; the second system had forty 5.5-liter aquaria. Salinity was 20.9 to 28.7%; water temperature, 10.1 to 30.8C; pH, 8.0 + or - 0.2. In the first system, the mean control adenosine triphosphate concentration was 0.55 microgram/liter. In aquaria treated with sodium hypochlorite, 0.125 mg/liter reduced the adenosine triphosphate to 87.1% of mean control concentration; 0.25 mg/liter, to 77.6%; and 0.5 mg/liter, to 66.8%. In the second system, the mean control adenosine triphosphate concentration was 0.40 microgram/liter. In aquaria treated with sodium hypochlorite, 0.47 mg/liter reduced adenosine triphosphate to 74.5% of the mean control concentration; 0.94 mg/liter, to 56.7%; and 1.41, to 42.5%. (Sims-ISWS)
W80-04220

THE RELATION BETWEEN PORE WATER CHEMISTRY AND BENTHIC FLUXES OF NUTRIENTS AND MANGANESE IN NARRAGANSETT BAY, RHODE ISLAND,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
R. J. McCaffrey, A. C. Myers, E. Davey, G. Morrison, and M. Bender.
Limnology and Oceanography, Vol 25, No 1, p 31-44, January 1980. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Pore water, *Nutrients, *Manganese, *Benthos, *Bottom sediments, *Rhode Island, Water chemistry, Advection, Sediment-water interfaces, Benthic fauna, Diffusion, Depth, Cores, Carbon cycle, Organic matter, *Narragansett Bay(RI).

Benthic fluxes of dissolved nutrients and manganese from biologically disturbed, relatively unpolluted sediment in Narragansett Bay, Rhode Island, have been measured. Analysis of the vertical gradients of chemical species dissolved in pore waters and the uptake of 22Na from the overlying water permit evaluation of the contribution of biological advection and molecular diffusion to the transport of dissolved material across the sediment-water interface. The activity of bottom-dwelling organisms appears to be about as important as molecular diffusion in most cases. The sum of the independently estimated contributions by both mechanisms is in good agreement with integrated benthic fluxes measured in situ. Sulfate and oxygen oxidize comparable amounts of organic matter in these sediments. (Visocky-ISWS)
W80-04251

A STUDY OF THE ROLE OF THE SEAGRASS POSIDONIA AUSTRALIS IN THE CARBON BUDGET OF AN ESTUARY,
Commonwealth Scientific and Industrial Research Organization, North Beach (Australia). Div. of Fisheries and Oceanography.
For primary bibliographic entry see Field 5C.
W80-04278

A NEW TECHNIQUE FOR MEASURING TIDAL CURRENTS BY USING A TWO-SITE HF DOPPLER RADAR SYSTEM,
National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
For primary bibliographic entry see Field 7B.
W80-04307

GROWTH OF THE AQUATIC PLANT MYRIOPHYLLUM SPICATUM IN A LITTORAL AREA OF THE HUDSON RIVER ESTUARY,
EG and G Environmental Consultants, Waltham, MA.
For primary bibliographic entry see Field 2I.
W80-04349

SALINITY INFLUENCE ON THE ECOLOGY OF PHYTOFLAGELLATE BLOOMS IN LOWER NEW YORK BAY AND ADJACENT WATERS,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab.
For primary bibliographic entry see Field 5C.

W80-04351

THE FLAX POND ECOSYSTEM STUDY: EXCHANGES OF INORGANIC NITROGEN BETWEEN AN ESTUARINE MARSH AND LONG ISLAND SOUND,
Marine Biological Lab., Woods Hole, MA.
G. M. Woodwell, C. A. S. Hall, D. E. Whitney, and R. A. Houghton.
Ecology, Vol 60, No 4, p 695-702, August 1979. 2 Fig, 1 Tab, 41 Ref. NSF AG-375.

Descriptors: *Estuarine environments, *Flax Pond(NY), *Cycling nutrients, *Long Island Sound(NY), *Nitrogen, Estuaries, Seasonal, Nitrogen compounds, Nitrites, Nitrates, Ammonia, Inorganic compounds, Anion exchange, Cation exchange, Coastal marshes, Salt marshes, Tides, Tidal effects, Nutrient budgets, Nutrient transport, Phytoplankton, New York.

From September 1972 to April 1974 water samples were collected from Flax Pond, an estuarine marsh on the north shore of Long Island, New York; the exchange of nitrogen between the marsh and Long Island Sound varied seasonally in response to several factors. The greatest variation occurs in nitrate; concentrations range 1.3-230 microg N/l. Nitrogen as ammonium ion occurs at concentrations 6-106 microg N/l; and nitrite in concentrations of 30-310 microg N/l. All three ions follow seasonal patterns that are similiar: highest concentrations are in winter, lowest are in spring during phytoplankton blooms. The largest gross movements of inorganic nitrogen occur during winter when concentrations are high and when up to 85 kg of nitrate-nitrogen are exchanged between Flax Pond and Long Island Sound on each tide. The largest net exchange occurs in late summer-early fall as ammonium is lost from Flax Pond to Long Island Sound. However, the annual net exchange of inorganic nitrogen does not differ significantly from zero since inorganic nitrogen lost in summer through outward exchange with Long Island Sound is replaced in winter through inward exchange. Crude estimations of the total inorganic nitrogen budget of Long Island Sound suggest that estuaries, precipitation, and rivers each contribute approximately equal inputs. (Harris-Wisconsin)
W80-04389

THE ROLE OF ZOOPLANKTON IN THE NITROGEN DYNAMICS OF A SHALLOW ESTUARY,
Duke Univ., Beaufort, NC. Marine Lab.
For primary bibliographic entry see Field 5C.
W80-04448

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

POLIOVIRUS MOVEMENT DURING HIGH RATE LAND FILTRATION OF SEWAGE WATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W80-04245

THE EFFECTS OF IRRIGATION WITH MEATWORKS-FELLMONGERY EFFLUENT ON WATER QUALITY IN THE UNSATURATED ZONE AND SHALLOW AQUIFER,
Canterbury Frozen Meat Co. Ltd. Christchurch (New Zealand).
G. M. Keeley, and B. F. Quin.
Progress in Water Technology, Vol 11, No 6, p 369-386, 1979. 6 Fig, 7 Tab, 23 Ref.

Descriptors: *Irrigation, *Waste water disposal, *Groundwater, Pollutants, Nitrates, Nutrients, Bacteria, Sampling, Path of pollutants, Pastures, Grazing, Drainage, Effluents, Soils, Soil water, Soil contamination, Water quality, *Meatworks-fellmongery wastes.

Land application of meatworks-fellmongery effluent has been carried out at Fairton in Canterbury (New Zealand) for 80 years. Approximately 900 mm of effluent is applied annually to 100 ha of shallow soil (overlying gravels), which is bordered for surface irrigation, sown in pasture, and used for fattening beef. Because of the high nutrient content of the effluent, much of which is attributable to the fellmongery operation, soil fertility has quickly been increased to the point where the majority of most nutrients (phosphorus being a notable exception) are lost in the drainage. Investigation showed that the chemical composition of the drainage became more homogeneous with depth. The drainage (which also totaled 900 mm annually) and effluent contained similar concentrations of the species relatively unaffected by soil processes (Cl, Na, and S04-S), but the 100 mg/liter of N in the effluent, most of which was present as NH4-N, was replaced by N03-N in the drainage, although the lower concentration (40 mg/liter) suggested that denitrification losses were considerable. Despite the shallow nature of the soil, bacterial numbers in the gravel substrata were much lower than in the topsoil. The chemical composition of the groundwater beneath the scheme, where the water table is 21 m below ground level, was similar to that of drainage collected from a depth of 6 m. A three-depth investigation well situated 500 m from the scheme in the direction of groundwater flow showed definite chemical and bacteriological contamination from the effluent irrigation scheme only in the shallowest of the three depths. (Sims-ISWS)
W80-04262

AN INTERNATIONAL COMPARISON OF TRENDS IN WATER RESOURCES MANAGEMENT,
Fordham Univ., Bronx, NY. School of Law.
For primary bibliographic entry see Field 6E.
W80-04498

3D. Conservation In Domestic and Municipal Use

AN INTERNATIONAL COMPARISON OF TRENDS IN WATER RESOURCES MANAGEMENT,
Fordham Univ., Bronx, NY. School of Law.
For primary bibliographic entry see Field 6E.
W80-04498

3F. Conservation In Agriculture

SUITABILITY OF REGION-WIDE IRRIGATION SCHEDULING BY LOCAL EVAPOTRANSPIRATION MEASUREMENT,
Nebraska Univ. Panhandle Station at Scottsbluff.
For primary bibliographic entry see Field 2D.
W80-04442

THE IRRIGATION REVOLUTION AND ITS ENVIRONMENTAL CONSEQUENCES,
For primary bibliographic entry see Field 6E.
W80-04490

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

URBAN STORMWATER MANAGEMENT, PROCEEDINGS OF A SOUTHEAST REGIONAL CONFERENCE, NORTH CAROLINA STATE UNIVERSITY, APRIL 10-11, 1979.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164627, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh. (1980) edited by Howells, D. H. 258 p. OWRT B-123-NC(6), 14-34-0001-9144.

Descriptors: *Storm water, *Urban runoff, *Storm runoff, *Urbanization, Water management(Applied), Erosion control, Drainage programs, Water control, Sedimentation, Flood plain zoning, Conferences, Documentation, Southeast U.S.

Proceedings of an invitational conference to identify and prioritize water resource problems and to define research and technology transfer needs for the Southeastern United States are presented. Water resources research institutes and water resource agencies in the following states were involved: Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. The theme of the conference was urban stormwater management with emphasis on drainage and detention, flood plain management, erosion and sedimentation control, and stormwater pollution control. The strengths and deficiencies of State and local urban stormwater management programs were examined and necessary steps to correct these weaknesses were discussed. Following the State, local, and regional program discussion two other papers were given: 'A Western Experience in Stormwater Management' and 'National Water Policy and Urban Stormwater Management'. Also given in the proceedings is a 'Model Surface Water Runoff Control Ordinance' for Florida. A list of conference participants is included. (Seigler-IPA)
W80-04201

LAND CAPABILITY FOR SURFACE WATER PRODUCTION,
Soil Conservation Authority of Victoria, Kew (Australia).
P. N. King.
Progress in Water Technology, Vol 11, No 6, p 501-520, 1979. 1 Fig, 13 Tab, 2 Ref.

Descriptors: *Land use, *Water quality, *Water yield, *Model studies, Mathematical models, Pollutants, Pathogenic bacteria, Phosphates, Nitrates, Pesticides, Oil, Heavy metals, Sediments, Heat, Water resources, Water supply, Watersheds(Basins), Agriculture, Domestic water, Surface waters.

This paper presented a summary of a Masters of Environmental Science thesis which developed two conceptual models predicting the effect of a combination of land features, land use, and land management on water quality and yield, and how the end use of water and its treatment would affect the suitability for use. Limited testing of the water yield submodel demonstrated how the models may be optimized. Both models may be combined for optimization of total water management strategies. (Sims-ISWS)
W80-04257

CHANGES IN PHOSPHORUS CONCENTRATION IN A EUTROPHIC LAKE AS A RESULT OF MACROPHYTE-KILL FOLLOWING HERBICIDE APPLICATION,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
For primary bibliographic entry see Field 5C.
W80-04276

HYDROLOGIC CONDITIONS IN BROWARD COUNTY, FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04378

THE PROTECTION OF HYDROLOGIC AND LAND PRESERVATION VALUES UNDER THE SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977: A WELCOME REFORM,

Appalachian Research and Defense Fund, Inc., Charleston, WV.
For primary bibliographic entry see Field 6E.
W80-04471

DEMORALIZED WETLANDS OWNERS: IS THERE JUST COMPENSATION AFTER BRECCIAROLI V. CONNECTICUT COMMISSIONER OF ENVIRONMENTAL PROTECTION.,
For primary bibliographic entry see Field 6E.
W80-04488

4B. Groundwater Management

POLIOVIRUS MOVEMENT DURING HIGH RATE LAND FILTRATION OF SEWAGE WATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W80-04245

EVALUATION OF METHODS FOR ESTIMATING GROUND-WATER WITHDRAWALS IN WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
C. H. Baker, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-175631, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-92, 1979. 70 p, 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Methodology, *Estimating, *Groundwater mining, *Withdrawals, *Kansas, Aquifers, Analytical techniques, Sampling, Pumping, Water utilization, Irrigation, Crops, Evaluation, *Western Kansas.

Individual users report ground-water withdrawals annually to the Kansas State Board of Agriculture. It is estimated that these values are 10 to 15 percent higher than actual values because most users do not possess the means for accurately determining discharge rates. Methods of estimating groundwater use in western Kansas that appear to offer the desired accuracy include (1) extrapolation from a sample of metered withdrawals, (2) calculation from precipitation and irrigated acreages of various crop types, and (3) calculation from a sample of power-coefficients. All three methods are being tested and compared with actual measured values. Newly developed electronic running-time and discharge-totaling meters are being tested that may give accurate values of total pumping time and discharge at small cost. (Kosco-USGS)
W80-04370

WATER RESOURCES OF THE SANTA ROSA INDIAN RESERVATION AND VICINITY, RIVERSIDE COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
A. Buono, W. R. Moyle, Jr., and P. Dana.
Available from: OFSS/USGS Box 25425, Fed. Ctr. Denver, CO, Paper copy $4.50 Microfiche $3.50. Geological Survey open-file report 79-1172, September 1979. 32 p, 8 Fig, 3 Tab, 27 Ref.

Descriptors: *Groundwater resources, *Indian reservations, *California, *Surface waters, *Water quality, Chemical analysis, Sampling, Sites, Drilling, Test wells, Potential water supply, Aquifer characteristics, Geology, Data collections, Measurement, Water levels, Streamflow, Precipitation(Atmospheric), Runoff, Evapotranspiration, *Santa Rosa Indian Reservation(Calif).

Additional water for irrigation is needed by the Santa Rosa Indian Reservation, Riverside County, California. Water in the area is derived from precipitation, which averages 12 inches annually, on three subbasins nearly surrounding the 17-square-mile reservation. No ground water flows in from outside the area. A supply well that taps sandy material overlying the pre-Tertiary basement complex showed a specific capacity of 0.4 gallon per minute per foot of drawdown. Estimates of specific yield for material encountered during drilling of three wells and a test hole ranged from 5 to 10 percent. A gravity survey outlined the thickest section of the aquifer in the Vandeventer Flat area, and test wells are proposed to determine its potential well yield. Damming streams to retain runoff (about 1,500 acre-feet per year, and more during periods of heavy precipitation) is also proposed. Analyses of water from the supply well and five major springs showed that ground water is suitable for irrigation except at Sulphur Spring, where the percent sodium of 97 exceeds recommended maximums, and at Bull Canyon Spring, where the specific conductance of 1,300 micromhos indicate a salinity hazard. (Kosco-USGS)
W80-04376

RESULTS OF TRANSIENT SIMULATIONS OF A DIGITAL MODEL OF THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. T. Hoxie.
Available from: OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Paper copy $2.00, Microfiche $3.50. Geological Survey open-file report 79-1280, 1979. 17 p, 7 Fig, 3 Tab, 4 Ref.

Descriptors: Model studies, *Simulation analysis, *Aquifer characteristics, *Wyoming, Projections, Computer models, Hydrogeology, Groundwater resources, Pumping, Industrial water, Irrigation wells, Water levels, Drawdown, *Arikaree aquifer(Wyo), *Southeastern Wyoming.

Revised ground-water pumpage data have been imposed on a ground-water flow model previously developed for the Arikaree aquifer in a 400 square-mile area in central Platte County, Wyo. Maximum permitted annual ground-water withdrawals of 750 acre-feet for industrial use were combined with three irrigation-pumping scenarios to predict the long-term effects on ground-water levels and streamflows. Total annual ground-water withdrawals of 8,806 acre-feet, 8,033 acre-feet, and 5,045 acre-feet were predicted to produce average water-level declines of 5 feet or more over areas of 99, 96, and 68 square miles, respectively, at the end of a 40-year simulation period. The first two pumping scenarios were predicted to produce average drawdowns of more than 50 feet over areas of 1.5 and 0.8 square miles, respectively, while the third scenario resulted in average drawdowns of less than 50 feet throughout the study area. In addition, these three pumping scenarios were predicted to cause streamflow reductions of 2.6, 2.0, and 1.4 cubic feet per second, respectively, in the Laramie River and 4.9, 4.7, and 3.7 cubic feet per second, respectively, in the North Laramie River at the end of the 40-year simulation period. (Kosco-USGS)
W80-04379

HYDROLOGIC AND GEOLOGIC DATA FROM THE UPPER EAST COAST PLANNING AREA, SOUTHEAST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-04381

HYDROLOGIC AND RELATED DATA FOR WATER-SUPPLY PLANNING IN AN INTENSIVE-STUDY AREA, NORTHEASTERN WICHITA COUNTY, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
J. Kume, L. E. Dunlap, E. D. Gutentag, and J. G. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-145891, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-105, 1979. 51 p, 4 Fig, 13 Tab, 7 Ref.

Descriptors: *Hydrologic data, *Water supply, *Planning, *Kansas, *Hydrogeology, Data collections, Groundwater, Water wells, Water levels, Water yield, Chemical analysis, Sites, Climatic data, Observation wells, Rainfall, Soil moisture, Crop production, Solar radiation, Aquifers, Drawdown, Pumping, Irrigation wells, Water conservation, Irrigation, Water management(Applied), *Wichita County(Kans).

Data are presented that result from an intensive geohydrologic study for water-supply planning in a 12-square-mile area in northeastern Wichita County, Kansas. These data include records of wells, test drilling, chemical analyses, groundwater levels, rainfall, soil moisture, well yield, solar radiation, crop yield, and crop acreage. Data indicate that water levels in the unconsolidated aquifer are declining at an average annual rate of about 1 to 2 feet per year (1950-78). This decline is the aquifer's response to pumping by irrigation wells for watering corn, wheat, grain sorghum, and other crops. (Kosco-USGS)
W80-04385

CONJUNCTIVE WATER USE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. M. Yevjevich.
Water International, Vol 4, No 3, p 17-24,30, September, 1979. 4 Fig.

Descriptors: *Conjunctive use, *Water management(Applied), *Water sources, Multi-purpose projects, History, Social impact, Economic justification, Legal aspects, Environmental effects, Political constraints, Computer models, Decision making, Optimization, Properties, Estimating, Systems analysis, Optimum development plans, Project planning, Water resources development, Water utilization, Water quality, Research priorities, Alternative water use.

The historical development of water resources planning and management over the last 100-150 years is reviewed. The present state-of-the-art is conjunctive use in the form of multi-structure, multi-purpose, and multi-source water resources systems. Basic concepts and dimensions of conjunctive water use are discussed with emphasis on integration of the water resources systems into the economic, social, environmental, legal, and political systems. Before a multi-source conjunctive use model can be developed, the following must be established: (1) commonalities and specificities of properties of various combinations of water sources; (2) basic, theoretically and experimentally verifiable, approaches to decomposition and recomposition of complex water resources systems; and (3) identification of subsystem properties, input, states and output processes. Optimization of decision making may follow general operational rules and equations, or a continual, real time approach. Several examples of conjunctive water use schemes are presented. These schemes depend on: (1) the number and position of water sources in relation to the user(s); (2) whether water(s) should be shifted between sources for any beneficial purpose; (3) whether water will flow through a conveyance structure uni-directionally or bi-directionally; and (4) topographical and economic constraints. Three avenues of research in conjunctive water use technology and the role of water quality are discussed. (Purdin-NWWA)
W80-04429

GROUND WATER MANAGEMENT IN GEORGIA,
Georgia Univ., Athens. Legislative Research Div.
J. E. Kundell.
Ground Water, Vol 18, No 1, p 77-79, January-February, 1980. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Ground water, *Water management(Applied), *Georgia, Water utilization, Withdrawal, Overdraft, Industrial plants, Surface water, Urbanization, Irrigation programs, Geomorphology, Land use, Geology, Water allocation(Policy), Water permits, State governments, Agriculture, Water rights.

Water quantity, rather than quality, is becoming increasingly important, not only in arid western states but also in humid eastern states like Georgia

which receives about 50 inches of precipitation annually. The Coastal Plain Province is the only area in Georgia underlain by extensive aquifers and is used for agriculture, forestry and recreation. Other areas depend primarily on surface water and are mainly urban/industrial. Industries are the major users of ground water but between 1970 and 1977 withdrawals have decreased by about 9% due to conservation measures and the use of more surface water. Rapid growth in agricultural irrigation has resulted in withdrawals increasing from 11% in 1970 to 18% of the total ground water use by 1977. Since 74% of the irrigation occurs in the southwestern portion of the State, historic lows were recorded in aquifers in the area during November, 1978. Irrigation withdrawals were exempted from the permit requirements of the 1972 Ground Water Use Act. This has led to an inability to manage the resource and questions regarding legal rights to the use of water. Measures may be taken during the 1980 session of the Georgia General Assembly to enable better management of the State's water resources. (Purdin-NWWA)
W80-04463

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF INCREASED LAND-USE UPON FRESHWATERS IN THE CENTRAL HIMALAYAS,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
For primary bibliographic entry see Field 2E.
W80-04312

ENVIRONMENTAL PROTECTION MOTIVATION IN COASTAL ZONE LAND-USE LEGISLATION,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04495

4D. Watershed Protection

POTENTIAL POLLUTANTS FROM AGRICULTURE--AN ASSESSMENT OF THE PROBLEM AND POSSIBLE CONTROL APPROACHES,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5B.
W80-04228

APPLICATION OF GEOMORPHIC PRINCIPLES TO ENVIRONMENTAL MANAGEMENT IN SEMIARID REGIONS,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
S. A. Schumm, M. T. Bradley, and Z. B. Begin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-169303, Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Colorado State University Completion Report No 93, February 1980. 43 p, 15 Fig, 27 Ref. OWRT B-150-COLO (2), 14-34-0001-7143.

Descriptors: *Erosion, *Geomorphology, *Terrain analysis, *Semiarid climates, Land management, Evaluation, Soil stability, Vegetation, Accelerated erosion, Gully erosion, Valleys, *Erosion control.

In many valleys of the semiarid West valley floors are either flat and vegetated without a channel, or they are gullied. Using previously collected data from the Piceance Creek area of western Colorado, it is possible to identify a valley-slope threshold above which, for a given drainage area, gullying is probable. Below this valley-slope threshold the valley floors are stable; above it they are susceptible to gullying. When the relations and techniques developed in western Colorado were applied to the Chalk Bluffs area of northeastern Colorado, it was determined that valley width was also a significant factor determining valley stability, and a ratio of valley slope to valley width could be used to identify at a given drainage area a threshold zone of valley floor instability. These relations explain the observed variability of gullies and also permit identification of those locations where gullying is probable.
W80-04443

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

CALCULATION OF THE TOTAL ANTHROPOGENIC LEAD IN THE SEDIMENTS OF A RURAL ONTARIO LAKE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W80-04210

ORGANIC CONTAMINANT BEHAVIOR DURING GROUNDWATER RECHARGE,
Stanford Univ., CA.
P. V. Roberts, P. L. McCarty, M. Reinhard, and J. Schreiner.
Journal of the Water Pollution Control Federation, Vol 52, No 1, p 161-172, January 1980. 8 Fig, 2 Tab, 14 Ref. EPA R-804431.

Descriptors: *Groundwater recharge, *Recharge wells, *Injection wells, *Pollutants, *Organic compounds, Path of pollutants, Water pollution, Groundwater, Recharge, Chemicals, Reclaimed water, Waste water(Pollution), On-site investigations, Observation wells, Chemical analysis, Analytical techniques, Pollutant identification.

Concentration changes of organic trace contaminants were measured in an aquifer that was being recharged by direct injection of reclaimed water. The reclaimed water was obtained by advanced treatment of secondary effluent, including lime addition, coagulation, and sedimentation; air stripping; recarbonation; ozonation; and sand filtration. Naphthalene showed evidence of biodegradation in the aquifer. The field retention capacity of chlorobenzene was approximately 0.32 g/cu m aquifer in equilibrium with a concentration of 4 micrograms/liter in the water. The ratio of chlorobenzene transport relative to water movement was approximately one thirty-sixth. Chloroform was transported more rapidly than chlorobenzene, approximately one-fifth as fast as water. The approach showed promise for predicting water quality behavior in a large-scale groundwater recharge project based on short-term observations near the injection well. Concentrations were in the range of 0.1 to 10 micrograms/liter. (Sims-ISWS)
W80-04219

RURAL NONPOINT SOURCE WATER QUALITY IN A SOUTHEASTERN WATERSHED,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5B.
W80-04221

THE TRANSPORT AND OXYGEN DEMAND OF ORGANIC CARBON RELEASED TO RUNOFF FROM CROP RESIDUES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5B.
W80-04226

POTENTIAL POLLUTANTS FROM AGRICULTURE--AN ASSESSMENT OF THE PROBLEM AND POSSIBLE CONTROL APPROACHES,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5B.
W80-04228

STUDIES ON THE CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF SOIL-FILTERED DAIRY-SHED EFFLUENT,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 5B.
W80-04229

FEASIBILITY OF WATER QUALITY IMPROVEMENT IN THREE ILLINOIS RIVERS,
Arizona Univ., Tucson. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 5B.
W80-04246

CLOSTRIDIUM PERFRINGENS AS A WATER POLLUTION INDICATOR,
Health Effects Research Lab., West Kingston, RI.
For primary bibliographic entry see Field 5B.
W80-04247

THE EFFECTS OF LAND USE AND HYDROLOGY ON GROUNDWATER QUALITY IN MID-CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
B. F. Quin, and R. J. Burden.
Progress in Water Technology, Vol 11, No 6, p 433-448, 1979. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Land use, *Hydrology, *Groundwater, *Water quality, Irrigation, Agriculture, Pastures, Grazing, Sampling, Water chemistry, Nitrogen compounds, Nitrates, Chlorine, Nutrients, Pollutants, Geology, Recharge, Water pollution, *New Zealand.

Groundwater quality in Mid-Canterbury, New Zealand, between the Rakaia and Ashburton rivers (an area of 300,000 ha) can be classified into three distinct zones based on land use and hydrology. Zone A contains 0-3.5 g/cu m N03-N and 0-5 g/cu m Cl and consists primarily of runoff from the foothills and seepage from the rivers. Zone B, which contains 6-12 g/cu m N03-N and 5-10 g/cu m Cl, is situated beneath and downstream of a 26,000-ha surface irrigation scheme and consists primarily of drainage from this scheme. Zone C contains 5-20 g/cu m N03-N and 10-30 g/cu m Cl and lies beneath nonirrigated land that is not adjacent to major river recharge areas. The groundwater in this zone consists of varying proportions of drainage from surface-irrigated, spray-irrigated, and nonirrigated land, and seepage from the rivers. Future trends in groundwater quality were discussed in the light of these results. (Sims-ISWS)
W80-04261

NITRATE AND CHLORIDE IN GROUNDWATER, SURFACE WATER AND DEEP SOIL PROFILES OF CENTRAL CANTERBURY, NEW ZEALAND,
Lincoln Coll., (New Zealand). Dept. of Soil Science.
J. A. Adams, A. S. Campbell, W. R. McKeegan, R. J. McPherson, and P. J. Tonkin.
Progress in Water Technology, Vol 11, No 6, p 351-360, 1979. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Nitrates, *Groundwater, *Surface waters, Chlorides, Agricultural runoff, Water wells, Aquifers, Sampling, Chemical analysis, Nitrogen, Nitrogen compounds, Water pollution, Water pollution sources, Pollutants, Path of pollutants, Water quality, *New Zealand, Trends.

Nitrate-N levels were found to be high in household groundwater wells and surface waters in the Lincoln area of Central Canterbury, New Zealand. A majority of Lincoln wells contained more than the limit for public water supplies of 10.2 mg/dm of nitrate-N recommended by the World Health Organization, whereas the majority of groundwater wells in other areas of Central Canterbury contained less than 5 mg/dm. A similar pattern occurred in surface waters, although nitrate-N levels were always lower than in groundwater. Nitrate-N levels decreased with well depth and fell to less than 1 mg/dm in wells tapping the deep (more than 35 m) confined artesian aquifer. Temporal variation in nitrate-N levels was investigated by weekly sampling of 12 Lincoln household

groundwater wells and 2 stream sampling sites in Lincoln. Nitrate-N levels were variable but rose significantly over the year with levels being highest and the rate of increase being greatest on the western side of Lincoln. The reason for the rapid increase in nitrate-N levels is unknown. Baseline stream nitrate-N levels were low but were considerably affected by groundwater inflows and point pollution sources. Chloride levels in groundwater and surface water were closely correlated with nitrate-N levels. Nitrate-N levels in the soil solution under more freely drained agricultural soils near Lincoln were similar to those observed in groundwater, suggesting that agriculture may be making a contribution to the nitrate-N load of groundwater in the study area. This is despite the fact that nitrogenous fertilizers are not widely used. On poorly drained soils, no evidence of vertical movement of nitrate was observed. (Sims-ISWS)
W80-04264

NITRATE REMOVAL FROM STREAMS DRAINING EXPERIMENTAL CATCHMENTS,
Ministry of Works and Development, Hamilton (New Zealand). Hamilton Science Centre.
For primary bibliographic entry see Field 5B.
W80-04265

NUTRIENT CONCENTRATIONS IN RUN-OFF FROM A GLEY PODZOL SOIL,
Canterbury University, Christchurch (New Zealand). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W80-04267

LOSSES OF PHOSPHORUS AND NITROGEN FORMS IN SUBSURFACE DRAINAGE WATER AS INFLUENCED BY PHOSPHATE FERTILIZER, GRAZING ANIMALS, AND IRRIGATION TREATMENTS,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W80-04268

FACTORS AFFECTING DOWNSLOPE MOVEMENT OF NUTRIENTS IN HILL PASTURE,
Department of Scientific and Industrial Reseach, Lower Hutt (New Zealand). Soil Bureau.
For primary bibliographic entry see Field 5B.
W80-04269

EFFECTS OF RURAL AND URBAN SOURCES OF PHOSPHORUS OF LAKE BURLEY GRIFFIN,
Canberra Coll. of Advanced Education (Australia). School of Applied Science.
For primary bibliographic entry see Field 5B.
W80-04270

SPRAY IRRIGATION OF DAIRY FACTORY WASTEWATER ONTO PASTURE--A CASE STUDY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W80-04271

QUALITY OF DRAINAGE WATER FROM PASTURE TREATED WITH DAIRY SHED EFFLUENT,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W80-04272

DIURNAL OXYGEN RHYTHM AND PRIMARY PRODUCTION IN THE MIXED LAYER OF THE ATLANTIC OCEAN AT 20 DEGREES N,
Nederlands Inst. voor Onderzoek der Zee, Texel.
S. B. Tijssen.
Netherlands Journal of Sea Research, Vol 13, No 1, p 79-84, October 1979. 2 Fig, 10 Ref.

Descriptors: *Dissolved oxygen, *Analytical techniques, *Primary productivity, *Atlantic Ocean, *Estimating, Volumetric analysis, Diurnal, Variability, Mixing, Surface waters, Oxygen, Measurement, Chemical analysis, Testing procedures, Water chemistry, On-site investigations, On-site laboratories, Tracers.

Oxygen concentrations varied 415-426 microg at/cu dm November-December 1978 in Atlantic Ocean mixed layers; these high values provide substantial evidence that past C14 primary production estimates for the oceans are severe underestimates. Past calculations of diurnal oxygen variation in oceanic mixed layers estimated that primary production was 150-250 mg C/sq m d. Measurements were based on a maximum diurnal oxygen variation of 0.5-1 microg at/cu dm, indicating 0.1-0.2% variation in oxygen solubility at ambient salinity and temperature conditions. Measuring such small differences is beyond the precision of standard Winkler methods. For these experiments a phototritrator was built with a high precision endpoint determination, giving 0.05-0.1% standard error. Diurnal oxygen rhythms with amplitudes $<0.6\%$ ambient oxygen concentrations occur at five stations in the mixed layer of the Atlantic Ocean at 20 degrees N. Oxygen concentrations per cast within the mixed layer at different depth levels are remarkably constant. Mean standard deviation within the mixed layer at one station is only 0.29 microg at/cu dm. High concentrations are occasionally found in the upper 10 m. Evening oxygen concentrations are consistently and significantly higher than morning concentrations, allowing for light period increase and dark period decrease. Spatial and between-days variability never exceeds the difference between the night values and the mean of both morning casts. Estimated gross primary production in the mixed layer is high and averages 800 mg C/sq m d. (Danovich-Wisconsin)
W80-04282

CURRENT C14 METHODS FOR MEASURING PRIMARY PRODUCTION: GROSS UNDERESTIMATES IN OCEANIC WATERS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
W. W. C. Gieskes, G. W. Kraay, and M. A. Baars.
Netherlands Journal of Sea Research, Vol 13, No 1, p 58-78, October 1979. 4 Fig, 7 Tab, 48 Ref.

Descriptors: *Tracers, *Primary productivity, *Analytical techniques, *Atlantic Ocean, *Estimating, Phytoplankton, Oceans, Chlorophyll, Algae, Surface waters, Sampling, Size, Volume, Mortality, Plankton, Organic matter, Euphotic zone, Fluorometry, Spectrophotometry.

Primary production measurements were made in situ in the North Equatorial Current, Atlantic Ocean November-December 1978; amounts of organic matter produced through autotrophic processes in tropical open ocean euphotic zones is 5-15 times higher than values derived from common C14 methods. The new estimates are based on measurements of C14 incorporation in organic matter of ocean samples incubated in 4 liter bottles; primary production estimates vary 100-750 mg C/sq m d. Incubation in smaller bottles causes abnormally high photochemical pigment destruction, presumably due to enhanced algal mortality. Detrimental enclosure effects are most serious in samples contained in 30 ml bottles for 12 hrs; effects are not significant in samples larger than 4 liters. Mortality in bottles may be caused directly by contact with glass walls, or indirectly because organic matter production and consumption in oligotrophic waters is easily upset when samples are enclosed. In uppermost euphotic layers, primary production is further underestimated because chlorophyll in algal cells incubated at a fixed depth bleaches more rapidly than chlorophyll in cells freely circulating in vertically mixed surface layers. Oceanic phytoplankton have high growth rates, with generation times in hours, not days. High heterotrophic activity takes place in conjuction with high organic matter primary production. Therefore, existing concepts of open ocean carbon cycling and solar energy conversion efficiencies need to be completely reconsidered since they have always been based on extremely low primary production values. (Danovich-Wisconsin)
W80-04284

EVALUATION OF PROTOCOLS FOR PESTICIDES AND PCB'S IN RAW WASTEWATER,
Little (Arthur D.), Inc., Cambridge, MA.
A. B. Caragay, and P. L. Levins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-113184, Price codes: A02 in paper copy, A01 in microfiche.
Environmental Protection Technology Series Report No EPA-600/2-79-166, November 1979. 108 p, 30 Fig, 40 Tab, 11 Ref, 2 Append. 68-01-3857.

Descriptors: *Testing procedures, *Pesticides, *Pollutant identification, *Analytical techniques, *Waste water(Pollution), Chromatography, Centrifugation, Waste identification, Chemical analysis, Water pollution sources, Aldrin, DDT, Dieldrin, Heptachlor, Chlorinated hydrocarbon.

Raw waste water from the municipal sewage treatment plant in Brockton, Massachusetts, was used to test the applicability of the Environmental Protection Agency protocol for screening industrial effluents for priority pollutions. Samples were analyzed both before and after dosing with 1-30 ppb of priority pesticides and PCB's. Among the pollutants tested for were alpha-, beta-, gamma-, and delta-BHC; heptachlor; aldrin; dieldrin; endrin; chlordane; toxaphene; arochlors; and others. The industrial protocol was adapted for raw waste water samples and the tests were designed to allow for the measurement of losses involved in each step. Protocol evaluation steps are: (1) extraction with 15% methylene chloride/hexane and centrifugation, (2) concentration by Kuderna-Danish evaporation, (3) interference removal by acetonitrile partition, (4) chromatography on Florisil and Sephadex LH-20, and (5) mercury treatment for sulfur removal. Assays were performed by gas chromatography using an electron capture detector. Results show that unless evaporation is performed rapidly the Kuderna-Danish step could cause significant sample loss. The use of mercury for extract clean up produces no significant pesticide loss. Use of the Sephadex LH-20 is recommended over the Florisil due to several clean up advantages. While the tested protocol worked well with pollutants at the ppb level there is some question about resolution at the ppt level. (Seigler-IPA)
W80-04300

FALLOUT PLUTONIUM IN AN ALKALINE, SALINE LAKE,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2H.
W80-04306

LOSS OF FLUOMETURON IN RUNOFF WATER,
Texas Agricultural Experiment Station, Bushland.
For primary bibliographic entry see Field 5B.
W80-04309

A SIMPLE TUBULAR PHYTOPLANKTON SAMPLER FOR VERTICAL PROFILING IN LAKES,
Ontario Ministry of the Environment, Ottawa. Water Resources Branch.
For primary bibliographic entry see Field 7B.
W80-04344

DIVERSITY AND INDICATOR SPECIES AS MEASURES OF WATER POLLUTION IN A SUBARCTIC LAKE,
For primary bibliographic entry see Field 5C.
W80-04346

DESCRIPTION AND USE OF AN IMPROVED METHOD FOR DETERMINING ESTUARINE ZOOPLANKTON GRAZING RATES ON PHYTOPLANKTON,
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.

F. B. Griffiths, and J. Caperon.
Marine Biology, Vol 54, No 4, p 301-309, 1979. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Zooplankton, *Phytoplankton, *Estimating equations, *Analytical techniques, *Grazing, Tracers, Radioactivity techniques, Feeding rates, Sampling, South West Arm(Australia), Port Hacking(Australia), Sydney(Australia), Australia, Plant populations, Estuarine environments, Standing crops, Estuaries, Laboratory tests, Saturation, Population dynamics.

A method developed for estimating zooplankton grazing rates on natural mixed phytoplankton populations does not depend on counting phytoplankton cells at the beginning and end of each experiment. The method involves adding C14-labelled, natural mixed phytoplankton populations, either as sole grazing substrate or as tracer, to mixed phytoplankton and zooplankton samples at ambient and above-ambient concentrations. Appearance rates of C14-labelled phytoplankton in zooplankton estimates the grazing rate. Experiments were conducted to measure following variables: (1) total zooplankton grazing rate; (2) phytoplankton concentrations necessary for saturated grazing to occur; (3) individual species grazing rates at ambient concentrations of both phytoplankton and zooplankton. Grazing rate constants for net-caught zooplankton concentrated to 46 and 28 times ambient estuarine levels are -0.14 and -0.12 phytoplankton standing stock/d, respectively. Amounts of phytoplankton grazed increase with increasing phytoplankton concentrations. The onset of saturated grazing occurs at concentrations 46 times ambient estuarine levels. However, observations were insufficient to establish absolute numerical values for saturated grazing. Experimental grazing rates, applied to phytoplankton standing stocks, October-November 1975 in South West Arm, Port Hacking, Australia, showed that zooplankton grazing was the major control factor of phytoplankton populations. (Harris-Wisconsin)
W80-04357

STAINING PREPARATIONS FOR PHYTOPLANKTON AND PERIPHYTON,
NUS Corp., Pittsburgh, PA. Ecological Sciences Div.
For primary bibliographic entry see Field 7C.
W80-04365

HYDROLOGIC CONDITIONS IN BROWARD COUNTY, FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04378

INTERACTIONS BETWEEN VASCULAR ACTIONS OF DETERGENT AND CATECHOLAMINES IN PERFUSED GILLS OF EUROPEAN EEL, ANGUILLA ANGUILLA L. AND BROWN TROUT, SALMO TRUTTA, L.,
Messina, Univ. (Italy). Dept. of Physiology.
L. Bolis, and J. C. Rankin.
Journal of Fish Biology, Vol 16, p 61-73, 1980. 9 Fig, 47 Ref.

Descriptors: *Toxicity, *Eels, *Brown trout, *Linear Alkylate Sulfonates, Animal physilogy, Detergents, Biochemistry, Inhibition, Animal metabolism, Chemical properties, Cytological studies, Mode of action, *Catecholamines, *Noradrenaline, *Gills, *Propanolol, *Tissue analysis.

Noradrenaline induced vasodilation in isolated perfused eel or trout gills was inhibited by propranolol, a beta - adrenergic blocking agent. The noradrenaline effect was much reduced in gills of fish which had been kept in 1 mg/l solutions of the detergent LAS (linear alkylate sulphonate; 12C chain length). LAS produced concentration-dependent vasodilation, which was inhibited by propranolol, in eel and trout gills. Noradrenaline produced additional vasodilation in eel and trout gills which had been dilated by 2 times ten to the minus eighth power M LAS but had no effect on trout gills perfused with 2 times ten to the minus seventh power M LAS. Gills from trout which had been kept in 0.1 mg/l LAS responded to noradrenaline normally but the propranolol inhibition appeared to be potentiated. (Deal-EIS)
W80-04388

EFFECTS OF SALINITY ON VEGETATION CONSUMPTION AND GROWTH IN GRASS CARP,
Florida, Univ., Gainesville. School of Forest Resources and Conservation.
M. J. Maceina, and J. V. Shireman.
The Progressive Fish-Culturist, Vol 42, No 1, p 50-53, 1980. 1 Tab, 26 Ref.

Descriptors: *Carp, *Salinity, *Growth rates, *Feeding rates, Habitats, Fry, Water chemistry, Toxicity, Fish behavior, Fish physiology, Salt tolerance, Brackish water, Freshwater fish, Animal metabolism, Grass carp, Estuaries.

Fingerling grass carp (Ctenopharyngodon idella), 90-130 mm long, were fed a satiation diet of duckweed (Lemna minor) at different salinities for a 14-day period. Daily food consumption ranged from 5.8 to 6.4% of body weight in fish held at salinities between 0.1 (fresh water) and 6 o/oo, declined significantly to 1.3% at 9 o/oo, and was nil at 12 o/oo. Dietary conversion rates of grass carp were less efficient at 3 and 6 o/oo salinity than in fresh water. Growth was reduced slightly at salinities of 3 and 6 o/oo and greatly at 9 o/oo. Consumption, growth, and survival data obtained in this study indicate that grass carp could inhabit brackish water estuaries and salt marshes of salinities up to 9 o/oo. (Deal-EIS)
W80-04395

THE EFFECT OF DISSOLVED OXYGEN AND SALINITY ON THE TOXICITY OF AMMONIA TO SMOLTS OF SALMON, SALMO SALAR L.,
Water Pollution Research Lab., Stevenage (England).
J. S. Alabaster, D. G. Shurben, and G. Knowles.
Journal of Fish Biology, Vol 15, p 705-712, 1979. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Dissolved oxygen, *Ammonia, *Toxicity, *Salinity, *Atlantic salmon, Mortality, Bioassay, Lethal limit, Water chemistry, Hardness(Water), Fish physiology, Salmonoids, Fish migration, *Acclimation.

The survival of Atlantic salmon smolts on exposure to constant concentrations of ammonia has been measured under laboratory conditions. At concentrations of dissolved oxygen close to the air-saturation value, the 24-h LC50 of unionised ammonia is 0.15 mg NH3/l in fresh water (hardness 264 mg/l as CaCO3) and 0.3 mg NH3/l in 30% sea water. At concentrations of dissolved oxygen of 3.5 mg/l in fresh water and 3.1 mg/l in 30% sea water, the 24-h LC50 is 0.09 mg NH3/l and 0.12 mg NH3/l respectively. For fish acclimated for 1 day to a concentration of ammonia close to the 24-h median for un-acclimated fish, the median is increased between 38 and 79%, depending on test conditions. (Deal-EIS)
W80-04397

THE EFFECTS OF INTERACTING SALINITY, CADMIUM, AND MERCURY ON POPULATION GROWTH OF AN ARCHIANNELID, DINOPHILUS GYROCILIATUS,
Oslo Univ. (Norway). Inst. of Marine Biology.
K. H. Roed.
Sarsia, Vol 64, p 245-252, 1979. 4 Fig, 6 Tab, 17 Ref.

Descriptors: *Salinity, *Mercury, *Cadmium, *Toxicity, Growth rates, Reproduction, Inhibition, Lethal limit, Mortality, Bioassay, Animal populations, Aquatic populations, Invertebrates, Worms, *Multivariate analysis, *Dinophilus.

After determining the 48-h LC50 values for cadmium and mercury, the long-term effects of 5% and 10% of these concentrations together with varying salinity on population growth progress of Dinophilus gyrociliatus O. Schmidt were investigated. Both the population growth rate and the time for the first generation to start reproduction have been studied. Significant effects were found for both two and three factor interactions. Using response surface methods, cadmium and mercury in combinations were shown to have increased effect as the salinity decreased and the two factor interactions were shown to change from antagonism at 30 o/oo to synergism at 25 o/oo. (Deal-EIS)
W80-04403

BEHAVIOURAL STUDIES ON MUSSELS UNDER CHANGING ENVIRONMENTAL CONDITIONS,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
J. Salanki.
Symposia Biologica Hungarica, Vol 19, p 169-176, 1979. 5 Fig, 20 Ref.

Descriptors: *Bioindicator, *Mussels, *Heavy metals, Animal behavior, Mercury, Cadmium, Insecticides, Herbicides, Pesticide toxicity, Water quality, Copper, Lead, *Anodonta.

The pumping behaviour of the fresh water mussel (Anodonta cygnea L.) was investigated under laboratory conditions with reference to artificial environmental factors, namely the presence of various pollutants. The continuous recording of shell activity and evaluation of changes in activity proved to be good indicators for testing the effect of chemicals. Mussels are rather sensitive to sulfhydryl blocking agents (Hg, Cd), which cause a marked shortening in their active periods. Some insecticides and herbicides shortening the mussels' activity also result in the reduction of water cleaning performed by mussels. (Deal-EIS)
W80-04404

EFFECT OF SOME PESTICIDES ON THE RHYTHMIC ADDUCTOR MUSCLE ACTIVITY OF FRESH-WATER MUSSEL LARVAE,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
I. Varanka.
Symposia Biologica Hungarica, Vol 19, p 177-196, 1979. 14 Fig, 1 Tab, 19 Ref.

Descriptors: *Pesticide toxicity, *Mussels, *Animal physiology, Larval growth stage, Inhibition, Insecticides, Nematocides, Herbicides, 2,4-D, Surfactants, Linear alkylate sulfonates, Bioindicator, Mollusks, *Tissue analysis, *Anodonta.

The toxicity of some pesticides which may enter fresh waters was examined on the larvae of fresh-water mussels. The decrease of tryptamine (TA)-induced adductor muscle activity was used as an indicator of the effect because it seemed to be suitable for the investigation of inhibitory effects. The following compounds were used: insecticides: Hungaria L-7, Dimecron-50, Thimet-10 G, Novenda, Bi-58 EC and Malathion; a nematocide: Shell-DD; herbicides: Gramoxon, Dikonirt and its active ingredient, the pure 2,4-D salt, as well as LAS, a surface-active agent. (Deal-EIS)
W80-04406

CORRELATION BETWEEN CADMIUM CONCENTRATION IN THE WATER AND TISSUE RESIDUE LEVELS IN DAB, LIMANDA LIMANDA L., AND PLAICE, PLEURONECTES PLATESSA L.,
Biologische Anstalt Helgoland, Hamburg (Germany, F.R.).
H. Von Westernhagen, V. Dethlefsen, and H. Rosenthal.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 45-58, 1980. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Cadmium, *Absorption, *Fish physiology, Water chemistry, Heavy metals, Growth rates, Toxicity, Mortality, Juvenile growth stage, Path of pollutants, Water temperature, Animal metabolism, Animal pathology, *Tissue analysis, *Bioaccumulation, *Dab, *Limanda, *Plaice, *Pleuronectes, *Fin erosion.

Juvenile dab, Limanda limanda L., and plaice, Pleuronectes platessa L., were kept in cadmium contaminated (5 microg/l, 50 microg/l) flow-through systems for 6 and 96 days. Accumulation of cadmium was measured in backbone, fins, gills, liver, muscle (fillet), otoliths and skin (dorsal and ventral). At both cadmium concentrations there was measurable accumulation after 6 days and significant accumulation in liver and gills after 96 days. At 50 microg/l, except for otoliths, all tissues tested showed significant uptake of cadmium. Growth and condition factors were not affected by either cadmium concentration. At 50 microg/l there was extensive mortality and plaice developed fin erosion. (Deal-EIS)
W80-04407

HUMAN IMPACTS ON BIOMASS, POPULATION SIZE AND YIELD-PER-RECRUITS OF ASP (ASPIUS ASPIUS L.) IN LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
P. Biro.
Symposia Biologica Hungarica, Vol 19, p 125-139, 1979. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Fish management, *Fish populations, *Commercial fishing, Productivity, Biomass, Yield equations, Mathematical models, Fish conservation, Commercial fish, Fish harvest, Nets, Lakes, Growth stages, Lake Balaton, Hungary, *Asp, *Aspius.

Responses of the relatively small asp (Aspius aspius L.) population to exploitation by commercial fisheries in Lake Balaton have been analysed. Yield of asp in Lake Balaton varied between 0.007 and 0.5 kg/ha. The quantity of asp caught annually at different areas of the lake is sufficiently constant (2.2-2.57 MT). The catch-per-unit effort (CPE) varied between 456 and 646 kg/yr, the rate of exploitation of the stock proved to be about 35.6 per cent, but the rate of production (P/B) was only 28.6 per cent. Annual loss of the population is about 49 per cent and the rate of survival is 51 per cent. The selectivity of the seines used in Lake Balaton basically influences the asymmetrical population structure removing the greater and older specimens of the stock. Asp in Lake Balaton basically influences the asymmetrical population structure removing the greater and older specimens of the stock. Asp in Lake Balaton has been intensively exploited. Rates of survival and exploitation heavily affect the size and stability of the harvestable asp population especially after the prerecruit phase. Rate of exploitation varies inversely in the function of stock abundance even at constant fishing effort. Under constant fishing pressure the stability and resilience of the relatively small asp population have been decreasing. These alterations are due to shifts in age-structure of the population and fluctuations in natural recruitment. These changes can be reversed to some extent by reducing the fishing intensity and enlarging the current mesh size of seines. (Deal-EIS)
W80-04409

OXYGEN-REGIME AND ARTIFICIAL AERATION OF NET-CAGES IN MARICULTURE,
Kiel Univ. (Germany, F. R.). Inst. fuer Meereskunde.
U. Kils.
Meeresforschung, Reports on Marine Research, Vol 27, No 4, p 236-243, 1979. 10 Fig, 11 Ref.

Descriptors: *Dissolved oxygen, *Aquiculture, *Equipment, *Oxygenation, Aeration, Oxygen requirements, Fish farming, Fish behavior, Flow rates, Water chemistry, Research equipment, Pumps, Fish management, *Artificial aeration.

The factors modifying the oxygen-regime in net-cages are shown and problems of artificial aeration pointed out. The only important 02-source of a net cage is the water exchange through the net-cover. The 02-content of the surrounding water, the stocking density and the net-cage size determine the oxygen-regime. A simple aeration with compressed air is not suitable for net-cages, on the contrary it can aggravate a critical 02-situation. A special net-cage-aerator is introduced and tested. This compact, self-floating aerator is easy to install in net-cages, delivers 02-saturated water without redundant turbulences and has a high oxygenation-capacity. An investigation on the fish reaction demonstrated that a net-cage-aerator of the displayed construction does not annoy the fishes in the cage. A swarm-like circular swimming motion of trout indensly stocked net-cages is not upset by the running aerator. (Deal-EIS)
W80-04410

SEASONAL AND ENVIRONMENTAL VARIATION IN MN, FE, CU AND ZN CONTENT OF SPARTINA ALTERNIFLORA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. L. Gleason, J. E. Drifmeyer, and J. C. Zieman.
Aquatic Botany, Vol 7, p 385-392, 1979. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Seasonal, *Heavy metals, *Marsh plants, Manganese, Iron, Copper, Zinc, Marshes, Aquatic plants, Plant physiology, Metabolism, Absorption, Virginia, Bennett's Marsh, Taskinas Marsh, *Bioaccumulation, *Tissue analysis.

Mn, Fe, Cu, and Zn in shoot tissue of Spartina alterniflora L. were analyzed for seasonal trends and relationships to dry matter standing crop. Two brackish marshes in Virginia were sampled four times between April and September 1975. Between early April and late May shoots accumulated Mn, Cu and Zn at a faster rate than dry matter standing crop increased. Fe followed this trend at Bennett's Marsh but matched standing crop increase at Taskinas Marsh. Tissue concentrations of Mn, Cu and Zn declined over the growing season at both marshes; Fe declined at Bennett's Marsh and increased at Taskinas Marsh. (Deal-EIS)
W80-04411

TOXICITY OF HEAVY METALS TO THE MARINE DIATOM DITYLUM BRIGHTWELLII (WEST) GRUNOW: CORRELATION BETWEEN TOXICITY AND METAL SPECIATION,
Melbourne Univ., Parkville (Australia). School of Botany.
G. S. Canterford, and D. R. Canterford.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 227-242, 1980. 11 Fig, 3 Tab, 30 Ref.

Descriptors: *Heavy metals, *Toxicity, *Diatoms, *Mathematical models, Copper, Zinc, Cadmium, Lead, Chemical properties, Mercury, Chemical reactions, Chelation, Growth rates, *EDTA, *Silver, *Thallium.

Toxicity of copper, zinc, cadmium and lead to Ditylum brightwellii decreased as the EDTA concentration was increased. However, increasing the EDTA concentration from 6.7 x ten to the minus 7th power to .00001 M had no effect on the toxicity of mercury, silver and thallium. Using the computer program COMICS a model describing the speciation of copper, zinc, cadmium, lead, mercury, silver and thallium in Si02 Stosch-modified Schreiber medium containing 1 x ten to the minus 7th power to .00001 M EDTA was constructed. For copper, zinc, cadmium and lead the free metal concentration was dependent on the concentration of EDTA in the medium. However, for mercury, silver and thallium the free metal concentration was independent of EDTA concentration. Correlation between experimental and theoretical data shows that heavy metal toxicity to D. brightwellii was related to the free metal concentration in the medium rather than the total metal concentration. The order of metal toxicity, based on the free metal concentration, was Hg2+>Ag+>Cu2+>Pb2+>Cd2+>Zn2+>Tl+. (Deal-EIS)
W80-04414

THE SEA-WATER WELL SYSTEM AT THE FISHERIES LABORATORY, LOWESTOFT AND THE METHODS IN USE FOR KEEPING MARINE FISH,
Ministry of Agriculture, Fisheries and Food, Lowestoft, (England). Fisheries Lab.
P. Scholes.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 215-225, 1980. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Marine fish, *Aquiculture, *Water wells, Sea water, Research equipment, Filtration, Sands, Fish management, Aquaria, Water chemistry, Fisheries, Marine fisheries, Water supply, Lowestoft, England.

A description is given of the shallow subsand seawater well system now in use at the Fisheries Laboratory, Lowestoft, England, to maintain for experimental purposes stocks of indigenous North Sea fishes. Chemical analyses of the well water show that it differs from usual inshore sea water in that it has a higher nitrate concentration and higher iron content, but fish both grow and spawn in this water and produce viable eggs and larvae. Advantages of the system are discussed. By provision of undergravel filtration fitted to individual tanks and an inflow of well water, whiting can be kept in a healthy condition at stocking densities of 10 kg cubic meter and flatfish such as dabs at 13 kg cubic meter. (Deal-EIS)
W80-04415

AN AQUATIC SAFETY ASSESSMENT ON LINEAR ALKYLBENZENE SULFONATE (LAS): CHRONIC EFFECTS ON FATHEAD MINNOWS,
Proctor and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
W. F. Holman, and K. J. Macek.
Transactions of the American Fisheries Society, Vol 109, p 122-131, 1980. 2 Fig, 8 Tab, 28 Ref.

Descriptors: *Linear alkylate sulfonates, *Toxicity, *Minnows, Detergents, Surfactants, Life cycles, Embryonic growth stage, Larval growth stage, Chemical properties, Organic compounds, Streams, Sewage effluents, Bioassay.

Life-cycle and embryo-larval toxicity tests were conducted on the fathead minnow (Pimephales promelas) with three commercial linear alkylbenzene sulfonates (LAS), anionic surfanctants commonly used in laundry detergents. The no-observed-effect concentration (NOEC), as measured in life-cycle tests or estimated from embryo-larval tests, depended on the mean alkyl chain length of the LAS and was 5.1 - 8.4, 0.48, and 0.11-0.25 mg/liter for C11.2, C11.7, and C13.3 LAS, respectively. The embryo and larval stages of development were consistently the most susceptible. The concentration of methylene blue active substances (MBAS), a nonspecific measure of anionic surfactants, was determined in over 800 widely distributed United States stream samples. The mean alkyl chain length of LAS in municipal sewage treatment effluents was C11.5. On the assumption that LAS contributes approximately 50% of the stream MBAS, 96 to 100% of the stream samples contained LAS at concentrations below the measured or estimated NOEC for fathead minnows. (Deal-EIS)
W80-04420

THE USE OF PERIPHYTON FROM LAKE ZURICH TO ESTIMATE THE ALGAL GROWTH POTENTIAL IN RIVER LIMMAT WATER,
Zurich Univ. (Switzerland). Hydrobiology-Limnology Station.
For primary bibliographic entry see Field 5C.
W80-04446

SUBFOSSIL CHIRONOMIDS AS EVIDENCE OF EUTROPHICATION IN EKOLN BAY, CENTRAL SWEDEN,
National Swedish Environment Protection Board, Uppsala. Limnological Survey.
For primary bibliographic entry see Field 5C.
W80-04453

ULTRAVIOLET RADIATION AND PHYTOPLANKTON PHOTOSYNTHESIS,

Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W80-04462

5B. Sources Of Pollution

EFFECT OF AGRICULTURE ON CEDAR LAKE WATER QUALITY,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 2H.
W80-04206

CALCULATION OF THE TOTAL ANTHROPOGENIC LEAD IN THE SEDIMENTS OF A RURAL ONTARIO LAKE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. D. Evans, and F. H. Rigler.
Environmental Science and Technology, Vol 14, No 2, p 216-218, February 1980. 2 Fig, 19 Ref.

Descriptors: *Lead, *Sediments, *Lake sediments, *Canada, Lakes, On-site investigations, On-site data collections, Sampling, Water pollution, Air pollution, Pollutants, Path of pollutants, Fallout, Data processing, Sedimentation, Anthropogenic lead.

Sediment cores from a rural Ontario lake (Bob Lake, latitude 44 deg 55 min N, longitude 78 deg 47 min W) were analyzed for total anthropogenic lead content. A high correlation between deposition of anthropogenic lead and sediment depth facilitated calculation of total fallout of anthropogenic lead in Bob Lake. The total fallout of 820 mg/sq m is large for a rural area in comparison to that calculated for the Lake Michigan-Chicago area (390 mg/sq m). (Sims-ISWS)
W80-04210

ACID PRECIPITATION IN THE WESTERN UNITED STATES,
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2K.
W80-04213

ORGANIC CONTAMINANT BEHAVIOR DURING GROUNDWATER RECHARGE,
Stanford Univ., CA.
For primary bibliographic entry see Field 5A.
W80-04219

RURAL NONPOINT SOURCE WATER QUALITY IN A SOUTHEASTERN WATERSHED,
North Carolina State Univ. at Raleigh.
F. J. Humenik, L. F. Bliven, M. R. Overcash, and F. Koehler.
Journal of the Water Pollution Control Federation, Vol 52, No 1, p 29-43, January 1980. 6 Fig, 8 Tab, 13 Ref. EPA R803328.

Descriptors: *Water quality, *Water pollution, *Watersheds(Basins), *North Carolina, *Virginia, *Atlantic Coastal Plain, Flow, Streamflow, Land use, Agriculture, Forests, Pollutants, Nutrients, Runoff, Water yield, Sampling, Data processing, *Nonpoint pollution.

Grab sample data from a 2-year study of forested and agricultural piedmont and well and poorly drained coastal plain areas of the Chowan River basin, Virginia-North Carolina, were analyzed to permit better understanding of rural runoff on an areawide basis. Mean nutrient concentrations for the four area types were relatively constant, but large spatial and temporal variations occurred within each area. There were large differences between data for piedmont and data for coastal plain, but variations between forested and agricultural piedmont and between well and poorly drained coastal plain were minor. Water and nutrient yields were greatest in winter and spring. Channelization of coastal streams appeared to promote high nitrate concentrations. (Sims-ISWS)
W80-04221

THE TRANSPORT AND OXYGEN DEMAND OF ORGANIC CARBON RELEASED TO RUNOFF FROM CROP RESIDUES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
J. D. Schreiber, and K. C. McGregor.
Progress in Water Technology, Vol 11, No 6, p 253-261, 1979. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Agricultural runoff, *Chemical oxygen demand, *Carbon, *Farm management, Sediments, Erosion, Biochemical oxygen demand, Water quality, Runoff, Crops, Corn(Field), Soils, Nutrients, Sampling, Data processing, Regression analysis, Agriculture, Crop residues, Tillage practices.

Chemical oxygen demand (COD), total organic carbon (TOC), and the 5-day biochemical oxygen demand (BOD sub 5) concentrations and losses were determined in runoff and sediments from conventional and no-till corn grown for silage (stalks removed) and for grain (stalks chopped and left on soil surface). Higher concentrations and losses of aqueous TOC and COD from grain plots resulted from organic carbon released from crop residues. Despite a wide range of residue management, one regression equation, $Y = 1.79X - 1.89$, related annual aqueous COD concentrations, Y in mg/l, to annual aqueous TOC concentrations, X in mg/l, for the research plots and watersheds. Although sediment TOC and COD concentrations (mg/kg) from the no-till grain and silage practices were considerably larger than those from comparable conventional practices, sediment TOC and COD losses from conventional practices were 6 to 13 times greater due to larger runoff and soil losses. While the annual average BOD sub 5 values were similar for the conventional silage and no-till for grain practices, 19.6 and 19.2 mg/l, respectively, these values differed seasonally. Where applicable, no-till seems to be a best management practice for corn to minimize the oxygen demand and losses of organic carbon in runoff from croplands. (Sims-ISWS)
W80-04226

SOURCES OF PHOSPHORUS IN THE LOUGH NEAGH SYSTEM AND THEIR REDUCTION,
Ministry of Agriculture, Crumlin (Northern Ireland). Freshwater Biological Investigation Unit.
R. V. Smith.
Progress in Water Technology, Vol 11, No 6, p 209-217, 1979. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Phosphorus, *Lakes, *Nutrients, Runoff, Water pollution, Sewage, Sewage treatment, Rivers, Watersheds(Basins), Drainage, Pollutants, Detergents, Sediments, Water pollution control, *Lough Neagh(Ireland).

Soluble reactive phosphorus is a critical nutrient in Lough Neagh and limits production of the algae in the lough. Accurate estimates of the input of soluble reactive P to the lough loads in each of the six major rivers were obtained by statistical modeling from continuous records of flow and concentrations of P measured every 8 days. Analysis of these data indicated that there was a significant correlation between the soluble reactive P loadings and the human, but not the animal, population densities of catchments. On the basis of the regression equations, the land drainage contribution of soluble reactive P was quantified as 0.14 kg P/ha/year and the rural per capita as 1.1 g P/person/day. If sewage works to towns of populations greater than 2000 were modified to incorporate P reduction stages, then about 40% of the available P to the lough could be curtailed. The effect of a complete detergent P ban would be to lower the sewage contribution of P by 50% loading to up to 40% curtailment of the available P input to the lough. Combining a ban and P reduction at sewage works could reduce the available P input by 60%. (Sims-ISWS)
W80-04227

POTENTIAL POLLUTANTS FROM AGRICULTURE--AN ASSESSMENT OF THE PROBLEM AND POSSIBLE CONTROL APPROACHES,
Cornell Univ., Ithaca, NY.
R. C. Loehr.
Progress in Water Technology, Vol 11, No 6, p 169-193, 1979. 10 Tab, 19 Ref, 1 Append.

Descriptors: *Water pollution, *Water pollution sources, *Agriculture, *Farm management, Farm wastes, Runoff, Fertilizers, Nutrients, Nitrogen, Phosphorus, Pollutants, Pesticides, Path of pollutants, Livestock, Feed lots, Crops, Soil conservation, Water pollution control, Erosion control, Reviews.

Agriculture has been identified as a potential source of water pollution as a result of: (1) the increasing intensity of many animal and crop producing operations; (2) the link that has been demonstrated between manure runoff, agricultural land runoff, and specific water pollution problems; and (3) the recognition, in certain areas, that control of municipal and industrial pollution may not be adequate to achieve desired water quality objectives. Although the relationships between animal and crop production practices, agricultural land use, and adverse impacts on water quality are largely empirical and general, there are approaches that can be used to minimize any adverse effect that agriculture might have. These approaches include runoff and erosion control practices; better timing and use of pesticides, fertilizers, and manure applications; and soil and water conservation practices. Many of these approaches are being utilized, and data on their effectiveness are available. This paper discussed both point and nonpoint potential agricultural pollutants in terms of: (1) sources, relative importance, and types of pollutants; (2) the magnitude of actual discharges; and (3) approaches and practices that can be used for the control of specific pollutants. (Sims-ISWS)
W80-04228

STUDIES ON THE CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF SOIL-FILTERED DAIRY-SHED EFFLUENT,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Div.
J. G. Cooke, R. W. Tillman, A. N. Macgregor, and J. K. Syers.
Progress in Water Technology, Vol 11, No 6, p 19-31, 1979. 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Waste water disposal, *Dairy industry, *Effluents, *Irrigation, *Sampling, Drainage, Pastures, Nutrients, Nutrient removal, Pollutants, Path of pollutants, Pollutant identification, Nitrogen, Phosphorus, Biochemical oxygen demand, Bacteria, Coliforms, Suspended solids, Hydrogen ion concentration, Farm wastes, Soil water, Waste disposal, Land management.

The discharge from a drained pasture disposal site receiving milking shed wastewater was sampled intensively over several 24-hour periods. The effluent was characterized in terms of nutrients (N and P forms), oxygen demand, coliform bacteria, solids, and pH. The efficiency of the disposal area in 'filtering' the wastewater was calculated and was found to be relatively constant between runs, despite the fact that with seasonal variations in antecedent soil moisture and rainfall, there were large differences in the volume of drainage water discharged. The patterns of flow and composition of the discharge were investigated. It was concluded that it would be dangerous to sample only during or near the regular diurnal peaks in flow rate associated with the twice daily milking schedule, without further investigations of the relationship of the flow rate to the parameter concerned. It was estimated that a sampling interval of no greater than one hour was required to provide estimates of loadings which were within 10% of the true values over all runs and all parameters. (Sims-ISWS)
W80-04229

DYNAMICS OF DISSOLVED OXYGEN DURING ALGAL BLOOM IN LAKE KASUMIGAURA, JAPAN,
Tsukuba Univ., Ikaraki (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W80-04242

POLIOVIRUS MOVEMENT DURING HIGH RATE LAND FILTRATION OF SEWAGE WATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
J. C. Lance, and C. P. Gerba.
Journal of Environmental Quality, Vol 9, No 1, p 31-34, January-March, 1980. 4 Tab, 15 Ref. EPA R-805,292.

Descriptors: *Viruses, *Sewage effluents, *Waste water(Pollution), *Groundwater recharge, *Land management, Infiltration, Sand aquifers, Water pollution sources, Filtration, Depth, Flow, Velocity, Adsorption, Loam, Wastes, Soils, Soil columns, Poliovirus movement, Secondary effluent, Sand filtration, Land application.

Research with soil columns that are good models of a field groundwater recharge system showed that most polioviruses are held near the soil surface. Secondary sewage effluent seeded with poliovirus type 1 (LSc) was filtered through 250-cm columns packed with calcareous sand from an area in the Salt River bed that is used for groundwater recharging of secondary sewage effluent. When the concentration of poliovirus added to the sewage water was increased from 0.9 x 100 to 2.6 x 10,000 PFU/ml, the number of viruses detected at each soil depth increased with the increasing virus concentration in the sewage water. However, the percentage of added viruses that remained at each depth was about the same for each concentration. The differences in the strength of the negative charge among members of a given viral population could account for the adsorption of some viruses near the soil surface while others move farther through the profile. Increasing the flow rate from 0.6 to 1.2 m/day caused a virus breakthrough of less than 1% of the added virus. However, 99% of the viruses still were removed from the infiltrating water at flow rates as high as 12 m/day. The velocity of water movement through the soil may be the single most important factor affecting the depth of virus penetration. (Visocky-ISWS)
W80-04245

FEASIBILITY OF WATER QUALITY IMPROVEMENT IN THREE ILLINOIS RIVERS,
Arizona Univ., Tucson. Dept. of Landscape Architecture.
D. C. Wilkin, and R. C. Flemal.
Journal of the Water Pollution Control Federation, Vol 52, No 2, p 293-298, February 1980. 10 Tab, 4 Ref.

Descriptors: *Water pollution sources, *Water quality, *Watersheds(Basins), *Rivers, *Illinois, Land use, Water pollution control, Water quality standards, Pollutants, Path of pollutants, Nitrogen, Ammonia, Iron, Copper, Lead, Phosphorus, Coliforms, Dissolved solids, Sampling, Data processing, Nonpoint pollution sources.

Three river basins in Illinois, varying in amount of urban and industrial development, have been studied to learn where pollution loadings originate and to determine what potential exists for water quality improvement. In all basins studied and for all constituents analyzed, complete elimination of all defined contributions would not greatly improve existing residual violation rates. Currently undefined contribution in these three basins, largely nonpoint-source pollution, holds the key to any substantive improvement. (Sims-ISWS)
W80-04246

CLOSTRIDIUM PERFRINGENS AS A WATER POLLUTION INDICATOR,
Health Effects Research Lab., West Kingston, RI.
J. W. Bisson, and V. J. Cabelli.
Journal of the Water Pollution Control Federation, Vol 52, No 2, p 241-248, February 1980. 4 Fig, 5 Tab, 13 Ref.

Descriptors: *Indicators, *Bioindicators, *Bacteria, *Tracers, Clostridium, E. Coli, Coliforms, Water pollution, Water pollution sources, Water quality, Monitoring, Sampling, Rivers, Estuaries, Beaches, Public health, Sewage effluents, Pollutants, Analytical techniques, Water pollution indicators.

Several potential applications of Clostridium perfringens as a water quality indicator were examined, including its use as an indicator of recreational water quality, a conservative tracer, a monitoring agent for chlorinated drinking water, and one component of indicator systems to determine the proximity and nature of sources of fecal pollution. The data from this preliminary study indicate that, while C. perfringens is not an appropriate indicator for recreational waters, it shows promise in the remaining areas, particularly as a conservative tracer and as a monitoring device for chlorinated drinking water. (Sims-ISWS)
W80-04247

THE CHEMISTRY OF THE RIVER WYE,
University of Wales. Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. C. Oborne, M. P. Brooker, and R. W. Edwards.
Journal of Hydrology, Vol 45, No 3/4, p 233-252, February 1980. 6 Fig, 7 Tab, 39 Ref.

Descriptors: *Rivers, *Water chemistry, *Water quality, Geologic control, River flow, Population, Land use, Spatial distribution, Runoff, Dry seasons, Wet seasons, Dissolved solids, Calcium, Magnesium, Sodium, Potassium, Bicarbonates, Silica, Nitrates, Phosphates, *Great Britain, *River Wye.

Samples collected during April 1975-December 1977 from 14 sites in the River Wye catchment were analyzed for total dissolved solids, calcium, magnesium, sodium, potassium, bicarbonate, reactive silica, nitrate, orthophosphate, suspended solids, and soluble organic carbon. The study period encompassed some of the most severe drought conditions recorded in the Wye catchment, and comparisons of the spatial and temporal variation in concentrations and mass flows of determinands were made from contrasting flow periods, September 1975-August 1976 (dry) and September 1976-August 1977 (wet), when flows in the lower Wye were 38% and 118%, respectively, of the longterm average. Spatial variations in water quality were related principally to geology (e.g., calcium) and population and land use (e.g., orthophosphate, nitrate). Significant flow-concentration relationships were established and, at all sites in both wet and dry periods, concentrations of most anions and cations were reduced by increased flow: nitrate and suspended-solids concentrations increased with increased flow. Annual subcatchment yields per unit area were substantially greater during the wet than the dry period and this was most marked in the lower catchment where differences in runoff between the two periods were greatest. Orthophosphate loads in both periods and nitrate loads in the dry period were significantly related to population density. (Visocky-ISWS)
W80-04248

BUFFERING OF SILICA AND PHOSPHATE IN A TURBID RIVER,
Maine Univ. at Orono, Walpole. Dept. of Oceanography.
L. M. Mayer, and S. P. Gloss.
Limnology and Oceanography, Vol 25, No 1, p 12-22, January 1980. 9 Fig, 36 Ref. NSF AEN72-03469, GI-34831.

Descriptors: *Silica, *Phosphates, *Rivers, *Turbidity, *Colorado River, Sediments, Dissolved solids, Sampling, Laboratory tests, Adsorption, Sorption, Chemistry, Water chemistry, *Buffering.

The buffering of riverine dissolved silica and phosphate by sorption reactions between the aqueous phase and suspended sediment was examined with the turbid Colorado River system as a model. Concentrations were found to lie in a range predicted from laboratory sorption experiments with natural sediments and waters. Phosphate was probably highly buffered by suspended sediment during river flow while silica was not. Silica appreciably affected phosphate sorption reactions but not vice versa. Increased temperature resulted in higher silica but lower phosphate concentrations as a result of sorption. The buffering action of suspended sediments was largely complete within a few hours and was approximately proportional to the concentration of suspended sediment. (Sims-ISWS)
W80-04252

MODELLING AND ANALYSIS OF DATA FROM CATCHMENT STUDIES OF LAND USE CHANGE,
National Research Advisory Council of New Zealand, Wellington.
For primary bibliographic entry see Field 2A.
W80-04254

DATA FILTERING TECHNIQUES AND REGIONAL ASSESSMENT OF AGRICULTURAL IMPACTS UPON WATER QUALITY, SOUTHERN ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
E. D. Ongley, and L. H. Broekhoven.
Progress in Water Technology, Vol 11, No 6, p 551-577, 1979. 8 Fig, 4 Tab, 10 Ref.

Descriptors: *Water quality, *Land use, *Agriculture, *Great Lakes, Agricultural runoff, Water pollution, Water pollution sources, Watersheds(Basins), Drainage, Runoff, Pollutants, Dissolved solids, Suspended solids, Nitrogen, Nitrates, Ammonia, Phosphorus, Chlorides, Hardness(Water), Regression analysis, Correlation analysis, Analytical techniques.

The study examined the effect of agriculture relative to other land uses upon river water quality at a regional level using 49 nonpoint (diffuse) source and 52 point source drainage basins in southern Ontario, and which are tributary to Lakes Ontario, Erie, Huron, and connecting waterways. Methods of data filtering were examined, and substantive relationships among river water quality and categories of land use were identified. Water quality data were mean annual concentration for the period 1968-72 for nutrients and other physical and chemical variables. Land use variables employed a reduced set of Canada Land Inventory categories which include agricultural and urban variables. Filtering techniques included correlation, factor, and discriminant analyses. Factor analysis did not effectively group these variables. Alternatively, discriminant analysis offered a rapid and convenient method for identifying those independent variables responsible for variations in water quality. Correlation was used to examine those relationships among variables which were identified by discriminant analysis. Although urban variables appear to be responsible for extremely high levels of total nitrogen, and total and soluble phosphorus found in a few basins, cropland appears to influence levels of those attributes in basins representing the top one-third of ranked mean annual values. Cropland is the single discriminating variable for basins having large suspended sediment concentrations and is strongly related to nitrate levels. (Sims-ISWS)
W80-04255

HYBRID APPROACH IN WATER QUALITY MANAGEMENT,
Goettingen Univ. (Germany, F.R.). Fachbereich Physik.
For primary bibliographic entry see Field 5G.
W80-04256

LAND CAPABILITY FOR SURFACE WATER PRODUCTION,
Soil Conservation Authority of Victoria, Kew (Australia).
For primary bibliographic entry see Field 4A.
W80-04257

AGRICULTURAL LAND USE AND ITS EFFECT ON CATCHMENT OUTPUT OF SALT AND WATER--EVIDENCE FROM SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2F.
W80-04259

THE EFFECTS OF LAND USE AND HYDROLOGY ON GROUNDWATER QUALITY IN MID-CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 5A.
W80-04261

THE EFFECTS OF IRRIGATION WITH MEATWORKS-FELLMONGERY EFFLUENT ON WATER QUALITY IN THE UNSATURATED ZONE AND SHALLOW AQUIFER,
Canterbury Frozen Meat Co. Ltd. Christchurch (New Zealand).
For primary bibliographic entry see Field 3C.
W80-04262

NITRATE AND CHLORIDE IN GROUNDWATER, SURFACE WATER AND DEEP SOIL PROFILES OF CENTRAL CANTERBURY, NEW ZEALAND,
Lincoln Coll., (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5A.
W80-04264

NITRATE REMOVAL FROM STREAMS DRAINING EXPERIMENTAL CATCHMENTS,
Ministry of Works and Development, Hamilton (New Zealand). Hamilton Science Centre.
R. A. Hoare.
Progress in Water Technology, Vol 11, No 6, p 303-314, 1979. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Nutrient removal, *Nitrates, *Streams, Nitrogen, Denitrification, Water quality, Land use, Springs, Sampling, Chemical analysis, Mathematical models, Water chemistry, Runoff, Rainfall, Watersheds(Basins), *New Zealand.

This paper showed that nitrate-nitrogen was naturally removed from the waters of a small stream, at a rate which can greatly affect estimates of the yield of nitrogen from the catchment. Four different methods were used to estimate the rate of nitrate-N removal, values for which were in the range of 0.2 to 0.9 g/sq m/day. These were similar to values found in other places where bacterial denitrification appeared to cause nitrate removal, but no conclusion can be drawn from this work about nitrate removal mechanisms acting in the catchment studied. These values, when interpreted with the aid of a simple mathematical model, suggested that it is likely that nitrate removal will be important in any comparison of catchments where the flow rate divided by streambed area in the first order tributaries is less than 5.9 cu m/sec/sq km. (Sims-ISWS)
W80-04265

MODELLING NITRATE CONCENTRATIONS IN PUMPED STORAGE RESERVOIRS,
Ministry of Works and Development, Hamilton (New Zealand). Hamilton Science Centre.
For primary bibliographic entry see Field 5G.
W80-04266

NUTRIENT CONCENTRATIONS IN RUN-OFF FROM A GLEY PODZOL SOIL,
Canterbury University, Christchurch (New Zealand). Dept. of Chemistry.
H. K. J. Powell, and M. C. Taylor.
Progress in Water Technology, Vol 11, No 6, p 295-301, 1979. 3 Fig, 10 Ref.

Descriptors: *Nutrients, *Runoff, *Pastures, *Nutrient removal, Agricultural runoff, Fertilizers, Phosphorus, Potassium, Sulfur, Calcium, Sampling, Chemical analysis, Water chemistry, Agriculture, *New Zealand.

Loss of nutrient in 'surface' runoff was studied for a pasture developed on a gley podzol soil under 2700 mm precipitation. The concentration of nutrients in runoff peaked significantly in the 3 months following fertilizer application (450 kg/ha of 30% potassic superphosphate), the relative concentrations being calcium greater than potassium greater than sulfur much greater than phosphorus. The mobility of nutrient in runoff was discussed in relation to the chemical properties of the soil and the levels of essential nutrients observed in pasture grass and clover. By ignoring base levels of nutrient arising from previous applications and from soil weathering, and assuming 0.8 for the fraction of precipitation appearing as 'surface' runoff, the estimated mass of nutrient lost (within 3-5 months of fertilizer application) was equivalent to 28% of potassium applied, 37% of sulfur, 40% of calcium, and 6% of phosphorus. (Sims-ISWS)
W80-04267

LOSSES OF PHOSPHORUS AND NITROGEN FORMS IN SUBSURFACE DRAINAGE WATER AS INFLUENCED BY PHOSPHATE FERTILIZER, GRAZING ANIMALS, AND IRRIGATION TREATMENTS,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
M. A. Turner, R. W. Tillman, and J. K. Syers.
Progress in Water Technology, Vol 11, No 6, p 287-294, 1979. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Nutrient removal, *Nitrogen, *Phosphorus, *Water quality, Agricultural runoff, Drainage, Tile drainage, Fertilizers, Grazing, Irrigation, Effects, Agriculture, *New Zealand.

The effects of phosphate (P) fertilizer, grazing animals, and irrigation treatments on losses of phosphorus (P) and nitrogen (N) forms in subsurface mole and tile drainage waters were investigated, under field conditions. Total P (TP) and total N (TN) losses ranged from 0.5-2.1 kg/ha and 7-43 kg/ha, respectively. For both P and N, most of the losses occurred as dissolved forms. Losses of dissolved inorganic P (DIP), total dissolved P (TDP), and TP were highest when all three treatments occurred together, intermediate with combinations of any two treatments, and lowest when only one treatment was present. For all comparisons, P fertilizer increased the losses of DIP, with the greatest increase being equivalent to approximately 1.8% of the P added. Losses of nitrate N (N03-N) and the percentage contribution of N03-N to total dissolved N (TDN) were highest with the grazing treatment. Grazing and irrigation treatments, and especially the interaction between the two, were important factors determining the magnitude of N03-N losses. (Sims-ISWS)
W80-04268

FACTORS AFFECTING DOWNSLOPE MOVEMENT OF NUTRIENTS IN HILL PASTURE,
Department of Scientific and Industrial Reseach, Lower Hutt (New Zealand). Soil Bureau.
R. H. S. McColl.
Progress in Water Technology, Vol 11, No 6, p 271-285, 1979. 3 Fig, 6 Tab, 17 Ref.

Descriptors: *Runoff, *Pastures, *Nutrients, *Overland flow, Agricultural runoff, Sampling, Rainfall, Organic matter, Dissolved solids, Nitrogen compounds, Nitrates, Phosphorus, Calcium, Magnesium, Sodium, Potassium, Fertilizers, Grazing, Sheep, Pollutants, Path of pollutants, Agriculture, *New Zealand.

Surface water was collected over 1 year during a study of the effects of season, sheep grazing, and fertilizer on downslope movement of nitrate, Kjeldahl nitrogen, phosphorus, calcium, magnesium, sodium, potassium, total solids, and organic matter in hill pasture, Taita, New Zealand. Nutrients moved short distances downslope in most rain events greater than 5 mm but long distances in three overland flow events during winter, which accounted for 75% of the year's water runoff. Estimates of the year's downslope movement showed that overland flow events accounted for about 60-80% of the nitrate, calcium, magnesium, sodium, total solids, and organic matter, and about 30-50% of the Kjeldahl nitrogen, total phosphorus, and potassium. About 45% of the Kjeldahl nitrogen and about 30% of the potassium moved downslope in events following within 5 days of grazing. About 34% of the total phosphorus movement occurred in two rain events following superphosphate application to recently grazed pasture; only 0.2% of the year's total moved in topdressed pasture with long grass. Estimated annual losses in surface water runoff (which was less than 1.2% of rainfall) from the experimental area were Kjeldahl nitrogen 0.59 kg/ha, nitrate nitrogen 0.23 kg/ha, and total phosphorus 0.11 kg/ha. These amounts of loss were less than atmospheric inputs. With the exception of rare overland flow events, the area studied did not contribute nutrients directly to streamflow as surface runoff from individual rain events and downslope movement was probably insignificant agriculturally. (Sims-ISWS)
W80-04269

EFFECTS OF RURAL AND URBAN SOURCES OF PHOSPHORUS OF LAKE BURLEY GRIFFIN,
Canberra Coll. of Advanced Education (Australia). School of Applied Science.
P. Cullen, and R. S. Rosich.
Progress in Water Technology, Vol 11, No 6, p 219-230, 1979. 6 Tab, 19 Ref.

Descriptors: *Phosphorus, *Lakes, *Sewage effluents, *Runoff, *Australia, Urban runoff, Agricultural runoff, Storm runoff, Monitoring, Sampling, Water pollution, Water pollution sources, Sediments, Eutrophication, Algae, Chlorophyll, Aquatic productivity, Nonpoint sources.

Lake Burley Griffin is a small (704 ha) artificial lake in the center of Canberra, Australia. Weekly monitoring of various forms of phosphorus to the lake over an 18-month period has enabled estimates to be made of phosphorus inputs and outputs from the lake. Flood events were shown to contribute 69% of the phosphorus, although these occupied only 9% of the study period. Of this flood phosphorus, 90% came from rural lands. Some 40% of the inflowing phosphorus was retained by the lake, mainly due to sedimentation. The application of the Vollenweider loading approach to the lake was discussed and compared to actual phosphorus concentration and biological production. (Sims-ISWS)
W80-04270

SPRAY IRRIGATION OF DAIRY FACTORY WASTEWATER ONTO PASTURE--A CASE STUDY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
K. W. McAuliffe, K. D. Earl, and A. N. Macgregor.
Progress in Water Technology, Vol 11, No 6, p 33-43, 1979. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Waste water disposal, *Dairy industry, *Irrigation, *Pastures, Spraying, Effluents, Waste disposal, Nutrients, Phosphorus, Nitrogen, Soil water, Groundwater, Infiltration, Water table, Fertilizers, Dissolved solids, Suspended solids, Pollutant identification, Farm management, Soil science, Casein wastewater.

Analyses were made of soil, soil water, and groundwater parameters at a pasture disposal site which had received casein wastewater for approximately 15 years. Effluent composition analyses suggest that large quantities of nutrients, such as nitrogen and phosphorus, have been applied to the site. Marked increases in both the inorganic and organic fractions of these nutrients in the soil have occurred. Associated with the chemical property alternations are a number of physical and biological changes, such as lower bulk density, higher levels of soil respiration, and increased earthworm numbers. Soil water analyses indicated that large quantities of nitrogen and phosphorus may be leached to the groundwater although groundwater samples remained constantly low in N03-N and DIP levels, suggesting that any percolating nutrients are diluted by the rapidly flowing groundwater. The implications of wastewater disposal on farm management practices were also discussed. (Sims-ISWS)
W80-04271

QUALITY OF DRAINAGE WATER FROM PASTURE TREATED WITH DAIRY SHED EFFLUENT,

Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
A. N. Macgregor, J. D. Stout, and R. J. Jackson.
Progress in Water Technology, Vol 11, No 6, p 11-17, 1979. 1 Fig, 7 Tab, 9 Ref.

Descriptors: *Waste water disposal, *Dairy industry, *Effluents, *Irrigation, Drainage, Pastures, Pollutants, Path of pollutants, Pollutant identification, Nitrogen, Phosphorus, Bacteria, Coliforms, Soil water, Farm wastes, Nutrients, Nutrient removal, Waste disposal, Land management.

Dairy shed effluent was sprinkler irrigated onto intensively drained permanent pasture. Subsurface drainage water from the pasture disposal site was examined for the forms and amounts of nitrogen and phosphorus and the numbers of fecal coliform bacteria present. Although soil conditions that permitted rapid movement of waste components into the subsurface drainage prevailed at times, it was estimated that not less than 90% of the N and 98% of the P were removed by passage through the pasture-soil system. (Sims-ISWS)
W80-04272

DESCRIPTIVE AND COMPARATIVE STUDIES OF MAINE LAKES,
Maine Univ. at Orono. Life Sciences and Agriculture Experiment Station.
For primary bibliographic entry see Field 2H.
W80-04286

PLANT PATHOGENS AS AGENTS FOR BIOLOGICAL AND INTEGRATED CONTROL OF AQUATIC PLANTS,
Wisconsin Univ.-Madison. Dept. of Plant Pathology.
J. H. Andrews.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-166473, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin Technical Completion Report 80-01, 1980. 36 p, 30 Fig, 6 Tab, 26 Ref. OWRT A-076-WIS(1), 14-34-0001-9053.

Descriptors: *Plant pathology, Pathogenic bacteria, Pathogenic fungi, *Plant diseases, Phytoplankton, Macrophytes, Plant groupings, *Aquatic weed control, Biocontrol, Eurasian water milfoil, Wisconsin, Lake Mendota(WI), Dane County(WI).

Field and laboratory observations were made during 1978 and 1979 on species composition and pathology of the phytoplankton and macrophyte communities in University Bay, Lake Mendota, Wisconsin. No evidence was found that pathogens play a significant role in the regulation of seasonal periodicity of phytoplankters or in inter-algal species competition. There was a pronounced general decline in macrophytes between 1978 and 1979 which may have been due to turbidity of the water. Disease appeared to be endemic rather than epidemic in the macrophyte community. All symptoms observed were in the atrophic or necrotic categories. Signs of disease were never apparent. Presumptive pathogens included fungi and bacteria obtained as singular and consistent isolates from surface-sterilized stem or leaf lesions. Demonstration of causality of fulfillment of Koch's Postulates was completed for Fusarium sporotrichioides, which causes stem lesions and apical chlorosis on Eurasian watermilfoil (Myriophyllum spicatum L.). Other presumed pathogens were isolated from milfoil following reinoculation, but did not induce characteristic symptom development. A fungus, identified tentatively as Trichothecium, grew endophytically in Eurasian milfoil and was associated with decline of the plant. Endophytic microorganisms appeared to be common in macrophytes and may offer the best prospect for biological suppression, or as the biological component of an integrated strategy for the control of nuisance aquatic macrophytes.
W80-04290

DISSOLVED OXYGEN IMPACT FROM URBAN STORM RUNOFF,
Sutron Corp., Arlington, VA.
T. N. Keefer, R. K. Simons, and R. S. McQuivey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-138266, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-156, November 1979. 248 p, 11 Fig, 18 Tab, 11 Ref, 4 Append. 68-03-2630.

Descriptors: *Dissolved oxygen, *Urban runoff, *Storm runoff, *Surface runoff, *Water pollution sources, Combined sewers, Water quality, Monitoring, Rainfall, Gaging stations, Streamflow, Correlation analysis.

Data from 104 water quality monitoring sites in and downstream of urban areas were evaluated to determine the correlation and the magnitude of the correlation between storm runoff and dissolved oxygen deficits downstream of urban areas. Of the 104 stations only 83 had sufficient data to produce results: 55 U.S. Geological Survey monitors, 17 STORET system monitors, and 11 Wisconsin Department of Natural Resources monitors. Forty-two percent of the monitors examined showed a 60% or more probability of a higher than average dissolved oxygen deficit for times of high stream flow or rainfall. This 60% probability was not found for all years at any given station but a frequency of 3 years in 5 was typical. At 22 of the monitor sites detailed hourly analysis show a diurnal cycle for dissolved oxygen concentrations. This cycle disappears during a storm event as flow increases and dissolved oxygen concentrations fall 1 to 1.5 mg/l below the minimum of the normal diurnal cycle low for one to five days. Dissolved oxygen levels of less than 5.0 mg/l were used as a standard for the study. Overall the probability is one in three that analysis of data from the monitors near urban areas will show a correlation between high flow and/or rainfall events and high dissolved oxygen deficits. The data base used for the correlation is not geographically homogeneous so no national conclusions can be drawn. (Seigler-IPA)
W80-04297

VERIFICATION OF THE WATER QUALITY IMPACTS OF COMBINED SEWER OVERFLOW,
Rexnord Inc., Milwaukee, WI. Environmental Research Center.
T. L. Meinholz, W. A. Kreutzberger, M. E. Harper, and K. J. Fay.
Environmental Protection Technology Series Report No EPA-600/2-79-155, December 1979. 200 p, 68 Fig, 29 Tab, 33 Ref, 2 Append. R-804518.

Descriptors: *Milwaukee River, *Combined sewers, *Dissolved oxygen, *Mathematical models, Water pollution sources, Coliforms, Urban runoff, Bottom sediments, Suspended solids, Oxygen demand, Water quality, Dredging, Regression analysis, Flow rates.

Water quality impacts in the Milwaukee River in terms of dissolved oxygen (DO) and fecal coliform concentrations following wet weather discharges were studied and modeled with a modified Harper's water quality model. Intensive field surveys and river dye studies show that river velocity is extremely slow in the lower reach near Lake Michigan even during high flow periods. Due to this slowness sediments accumulate in the lower river forming a significant sink for DO. Oxygen demand for these sediments when disturbed can be as high as 1000 gm/sqm-day or more than 100 times greater than the demand for undisturbed sediments. A rapid decline in DO is often observed following combined sewer overflows (CSO) that cannot be entirely attributed to the loadings from the CSO. The rapid DO decline is linked to the scouring of sediment oxygen demand by submerged CSO outfalls. Using regression analysis empirical equations were developed to predict CSO sediment scouring impacts on DO. Harper's water quality model was modified, calibrated, and verified for the simulation of fecal coliform and DO river conditions with various dry, wet, and CSO events. It is recommended that the feasibility of a periodic dredging program for the river be examined as a means of alleviating the DO problems. (Seigler-IPA)
W80-04299

METHANE ADDITION TO AN ARCTIC LAKE IN WINTER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, J. W. M. Rudd, and D. W. Schindler.
Limnology and Oceanography, Vol 25, No 1, p 100-113, January 1980. 12 Fig, 5 Tab, 20 Ref.

Descriptors: *Methane, *Lakes, *Winter, *Arctic, Effects, Dissolved oxygen, On-site investigations, Ice cover, Hydrogen ion concentration, Alkalinity, Carbon, Electrical conductance, Nitrogen, Phosphorus, Silica, Chlorides, Water chemistry, Pollutants, Water pollution, Path of pollutants.

The possible use of buried pipelines to transport natural gas (about 99% methane) through the Canadian arctic prompted a study of some of the dynamics of methane metabolism in an arctic lake at 63 deg 38 min N Lat. The two basins of the lake were separated during winter 1977-1978 by a curtain, and 300 kg of methane was dissolved into one side, to a maximum of 120 micro M/liter or 0.7 M/sq m. Oxidation occurred throughout the water column, but the highest rates were at or near the sediment surface. High phosphate and nitrate additions did not stimulate oxidation. The sediments generated methane naturally, and winter concentrations in undisturbed lakes were 0.2-1.0 micro M/liter. The added methane disappeared at a slow, steady rate of 1.89 mM/sq m/d or 0.32 micro M/liter/d from February to June. The oxygen depletion rate of the entire experimental basin was 0.244 g/sq m/d, compared with 0.210 in the control basin, and was not measurably affected by artificially added methane; a winter pipeline rupture would therefore probably not result in severe oxygen depletion in downstream lakes. These and other results were not expected based upon knowledge of methane dynamics in temperate lakes. (Sims-ISWS)
W80-04308

LOSS OF FLUOMETURON IN RUNOFF WATER,
Texas Agricultural Experiment Station, Bushland.
A. F. Wiese, K. E. Savage, J. M. Chandler, L. C. Liu, and L. S. Jeffery.
Journal of Environmental Quality, Vol 9, No 1, p 1-5, January-March 1980. 2 Fig, 5 Tab, 29 Ref.

Descriptors: *Pesticides, *Herbicides, *Runoff, *Water pollution sources, Sampling, On-site investigations, On-site data collections, Chemical analysis, Agricultural runoff, Pollutants, Path of pollutants, Pollutant identification, Agriculture, *Fluometuron.

The amount of fluometuron in runoff water under different environmental conditions was determined in the southern U.S. and Puerto Rico. In Mississippi, Puerto Rico, and Texas, runoff water was collected from soil sprayed with 4.4 kg/ha of fluometuron each year for 3 years. Tests were conducted in Tennessee for 2 years and in North and South Carolina for 1 year. Water samples were collected in 4- by 10-m plots, and 1 m downslope. Initial runoff was produced with sprinkler irrigation immediately after herbicide application at all locations except Tennessee and South Carolina which relied on rainfall. Later in the season, water was sampled from two additional runoff events of either irrigation or rainfall. A total of 32 runoff events were sampled at the 6 locations. The level of fluometuron in water caught 1 m downslope from treated areas during the first runoff averaged 0.30 ppm and was highest (0.87 ppm) in Puerto Rico. Fluometuron concentration in subsequent events was much lower than in the first runoff events. Average loss of fluometuron in 1 cm of runoff was less than 1% of applied fluometuron. Only 2% of applied fluometuron was lost in the situation producing the highest concentration in runoff water. Level of fluometuron in runoff water was directly related to slope. Results of this study indicated that fluometuron concentrations in runoff from treated fields are such that nontarget species should not be adversely affected. (Sims-ISWS)
W80-04309

DESIGN CRITERIA FOR COOLING-WATER OUTLET STRUCTURES,
Karlsruhe Univ., (Germany, F.R.).
M. Schatzmann, and E. Naudascher.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY3, Proceedings Paper 15239, p 397-408, March 1980. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Cooling water, *Dispersion, *Rivers, *Model studies, Mathematical models, Hydraulic models, Outlet works, Water pollution, Thermal pollution, Effluents, Design, Environmental engineering.

This paper described some laboratory studies utilizing buoyant and nonbuoyant tracers to investigate the effects of the initial conditions on the lateral mixing of cooling water or wastewater discharge into rivers. The paper began with a short phenomenological description of the dispersion of cooling-water side discharges into rivers from which a concept for quantifying the effect of the outfall parameters on the near-field mixing is then deduced. By means of a virtual-source concept and two bulk parameters describing the stability of the near-field density stratification and the strength of an assumed reference source, the results can be presented in a straightforward graphical form. These graphs provide a first estimate of design criteria for an outlet structure which is to be designed to maximize the rate of near-field mixing for a given cooling-water discharge. (Sims-ISWS)
W80-04310

EFFECTIVENESS OF SUBMERSED ANGIOSPERM-EPIPHYTE COMPLEXES ON EXCHANGE OF NUTRIENTS AND ORGANIC CARBON IN LITTORAL SYSTEMS. III. REFRACTORY ORGANIC CARBON,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
A. M. Mickle, and R. G. Wetzel.
Aquatic Botany, Vol 6, No 4, p 339-355, August 1979. 9 Fig, 25 Ref. NSF BMS-75-20322, DEB-75-203220A01, DOE EY-76-S-02-1599, COO-1599-142.

Descriptors: *Macrophytes, *Organic compounds, *Littoral, *Fulvic acids, *Nutrient removal, Scirpus, Myriophyllum, Pollution abatement, Plant physiology, Seasonal, Metabolism, Epiphytes, Organic matter, Organic loading, Biochemistry, Allochthonous material, Filters, Organic acids.

Submersed macrophyte-epiphyte complexes possess physical and metabolic mechanisms which substantially reduce the quantity and quality of allochthonous refractory organic compounds entering a lake. While some of these compounds entering a lake littoral zone pass through unchanged, a large portion interacts with the macrophyte-epiphyte complex. Experiment results suggest that macrophyte-epiphyte complexes are effective in removing refractory organic compounds; however, this effectiveness varies with season and species. Experimental design is comprised of two continuously flowing systems: System I contains a natural Scirpus subterminalis population and System II contains Myriophyllum heterophyllum. Epiphytes are left intact. Refractory dissolved organic compounds, consisting mainly of fulvic acids labelled with C14, are added to inflow water. DOC concentrations in outflow waters from littoral complexes of both experimental systems are higher than those from control (no plant) complexes. This increase is evident in DOC of compounds > 1000 Daltons in System II; in System I, this increase occurs in DOC > 10,000, but mainly in compounds > 30,000 Daltons. Outflow waters from experimental littoral complexes show a substantial decrease in calcium concentration. This reduction is caused by CaCO3 precipitation induced by photosynthesis. UV absorption and flourescence are higher in littoral complex outflow waters than in control outflow waters. The difference is much greater in System I than System II; this results from continual senescence by the perennial Scirpus species. (Danovich-Wisconsin)
W80-04348

ACTIVE WASTE-INJECTION SYSTEMS IN FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. Vecchioli, D. J. McKenzie, C. A. Pascale, and W. E. Wilson.
Available from: OFSS Bx 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.50, Microfiche $3.50. Geological Survey open-file report 79-1296, 1979. 33 p, 13 Fig, 1 Tab, 27 Ref.

Descriptors: *Waste disposal, *Injection wells, *Liquid wastes, *Monitoring, Aquifers, Industrial wastes, Sewage, Water pollution sources, Data collections, Florida.

As of the end of 1976, seven systems were injecting liquid wastes into Florida's subsurface environment at a combined average rate of 15 million gallons per day. This report presents for each of these systems information on the kind and amount of waste injected and type of pretreatment, construction characteristics of the injection and monitor wells, type of test and monitoring data available, and brief discussion of any operational problems experienced. (Kosco-USGS)
W80-04368

SUMMARY OF HYDROLOGIC DATA FOR TAMPA BYPASS CANAL SYSTEM, JULY 1974 TO SEPTEMBER 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 8B.
W80-04373

A PROPOSED GROUND WATER QUALITY MONITORING NETWORK FOR IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7A.
W80-04374

STORMWATER-RUNOFF DATA FOR A MULTIFAMILY RESIDENTIAL AREA, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04375

QUALITY OF SURFACE WATER ON SANIBEL ISLAND, FLORIDA, 1976-77,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. F. McPherson, and T. H. O'Donnell.
Available from: OFSS/USGS Box 25425, Fed. Ctr. Denver, CO, Paper copy $7.25 Microfiche $3.50. Geological Survey open-file report 79-1478, 1979. 50 p, 14 Fig, 12 Tab, 6 Ref.

Descriptors: *Water quality, *Surface waters, *Florida, *Surface-groundwater relationships, *Pollutants, Water pollution sources, Saline water intrusion, Artesian aquifers, Sampling, Sites, Water resources, Hydrologic data, *Sanibel Island(Fla).

The quality of surface water in parts of the interior of Sanibel Island, Fla., has been periodically degraded by high concentrations of salt or macronutrients and by low concentrations of dissolved oxygen. In 1976 the chloride concentration of surface water ranged from about 500 milligrams per liter to almost that of seawater, 19,000 milligrams per liter. The highest salinities were during the dry season of 1976 in the Sanibel River near the Tarpon Bay control structure and are attributed to leakage of saline water past the structure. The highest concentrations of macronutrients occurred during the dry season in the eastern reach of the Sanibel River, where concentrations generally exceeded 4.0 milligrams per liter total nitrogen and 0.9 milligrams per liter total phosphorus. Concentrations of dissolved oxygen were lowest in the wet season along an eastern reach of the Sanibel River and in several nearby ponds and canals where near-anaerobic conditions prevailed. The high concentration of macronutrients and the low dissolved oxygen are attributed, in part, to urban and sewage effluent that flow directly or seep into surface water. (Kosco-USGS)
W80-04377

GROUND-WATER QUALITY IN THE UPPER SANTA ANA RIVER BASIN, SOUTHERN CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
L. A. Eccles.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-161888, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-113, December 1979. 51 p, 15 Fig, 2 Tab, 11 Ref.

Descriptors: *Groundwater, *Water quality, California, *Water pollution sources, *Nitrates, Dissolved solids, Model studies, Water wells, Sampling, Monitoring, Networks, Chemical analysis, *Upper Santa Ana River basin(Calif).

The principal ground-water quality problems in the Santa Ana River basin, as determined from two samplings (1968-69 and 1977-78), are high concentrations of dissolved solids in general and nitrate-nitrogen in particular. The distribution of dissolved solids exceeding 800 milligrams per liter was smaller in area in 1977-78 than in 1968-69. Distribution of nitrate-nitrogen exceeding 10 milligrams per liter was larger in area in 1977-78 than in 1968-69. Concentrations of dissolved solids and nitrate-nitrogen decreased with depth. The network of wells used in the 1977-78 sampling program provides only a general appraisal of overall quality for most of the upper Santa Ana River basin. It is not adequate for detailed appraisals of specific problem areas because it lacks sufficient areal coverage and construction information for the wells sampled. (Kosco-USGS)
W80-04383

RESPONSE OF THE TENCH (TINCA TINCA L.) TO POTASSIUM NITRATE ENRICHED WATER,
Lyon-1 Univ., Villeurbanne (France). Lab. de Physiologie Generale et Comparee.
A. Demael, D. Garin, and G. Peres.
Journal of Fish Biology, Vol 16, p 15-22, 1980. 7 Tab, 22 Ref.

Descriptors: *Fish physiology, *Toxicity, *Potassium, Animal metabolism, Membrane processes, Osmosis, Ions, Water chemistry, Chemical reactions, Biochemistry, Sodium, Electrolytes, Freshwater fish, Potassium nitrate, *Tench, *Tinca, *Osmoregulation, *Blood chemistry, *Tissue analysis.

When the tench (Tinca tinca L.) was exposed to a slight increase, 8.5 mg/l, in the potassium content of the water, metabolic and hormonal changes occurred which lasted more than four weeks. An initial phase of lipolysis was followed by a partial consumption of glycogen reserves, which in turn was followed by a phase of gluconeogenesis. Hyperglycaemia persisted throughout the experiment. The ion distribution in erythrocytes and liver changed relatively early; there was no observable change in water content. These changes are similar to those observed during the osmoregulation of fish. (Deal-EIS)
W80-04387

BIOACCUMULATION AND BIOAMPLIFICATION OF MERCURY COMPOUNDS IN A THIRD LEVEL CONSUMER, SALMO GAIRDNERI, INFLUENCE OF THE TEMPERATURE FACTOR (IN FRENCH),
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Animale.
A. Boudou, F. Ribeyre, A. Delarche, and R. Marty.
Water Research, Vol 14, p 61-65, 1980. 6 Fig, 8 Ref, (English abstract).

Descriptors: *Mercury, *Food chains, *Path of pollutants, Heavy metals, Trophic level, Rainbow trout, Chlorella, Chlorophyta, Daphnia, Livebearers, Mortality, Bioassay, Water chemistry,

Water temperature, *Bioaccumulation, *Bioamplification, *Tissue analysis.

The bioaccumulation and bioamplification of mercury compounds in a third level consumer, Salmo gairdneri have been quantified. The direct contamination is analysed by mortality tests and by metal dosing both in fish and in their principal organs. This study was made with regard to the chemical form of the pollutant (HgCl2 and CH3HgCl), the dose introduced in the environment, the length of contamination, and the temperature. An interspecific comparison of the direct toxicity is made with Carrassius carrassius. The global contamination (water and food) was quantified using an experimental trophic chain of four levels: Chlorella vulgaris, Daphnia magna, Gambusia affinis and Salmo gairdneri. The methyl-mercury concentration in the water was 1 ppb, the water temperature was 10, 18 and 26C and the length of contamination was 10 and 30 days. The mercury bioaccumulation, expressed by means of concentration factors with regard to the contaminant dose in the water, is strongly influenced by the temperature: 2500 at 10C, 5900 at 18C and 3100 at 26C. Our results show the clear preponderance of the trophic contamination with regards to the direct contamination. (Deal-EIS)
W80-04396

PESTICIDE RESIDUES IN LAKE BALATON,
Heavy Chemical Industry, Veszprem (Hungary). Research Inst.
G. Y. Pfeifer, J. E. Ponyi, and Z. Nagy.
Symposia Biologica Hungarica, Vol 19, p 21-26, 1979. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Pesticide residues, *Lakes, DDT, Chlorinated hydrocarbon pesticides, 2,4-D, DDE, Herbicides, Chemical analysis, Water chemistry, Plankton, Mussels, Carp, Organophosphorus pesticides, Gas chromatography, *BHC, *Lindane, *Bream, *Abramis, *Tissue analysis, *Bioaccumulation.

No residues of chlorinated hydrocarbons, e.g. DDT and metabolites and BHC isomers, have lately been found in samples of water, plankton, mussel and fish (bream, Abramis brama L. and carp, Cyprinus carpio L.) from Lake Balaton. In the liver and fat of pikeperach (Stizostedion lucioperca L.) lindane has been found (10-30 ppb) but this value is not statistically significant because of the limited number of samples. The lake seems to be free of chlorinated insecticide residues due to the total ban of DDT and other chlorinated type insecticides in 1970. A residue of 2,4-D has been found in the water samples collected from the lake. (Deal-EIS)
W80-04402

CORRELATION BETWEEN CADMIUM CONCENTRATION IN THE WATER AND TISSUE RESIDUE LEVELS IN DAB, LIMANDA LIMANDA L., AND PLAICE, PLEURONECTES PLATESSA L.,
Biologische Anstalt Helgoland, Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W80-04407

SEASONAL AND ENVIRONMENTAL VARIATION IN MN, FE, CU AND ZN CONTENT OF SPARTINA ALTERNIFLORA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W80-04411

COPPER-THE MAJOR METAL COMPONENT OF GLYCERID POLYCHAETE JAWS,
Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.
P. E. Gibbs, and G. W. Bryan.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 205-214, 1980. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Copper, *Polychaetes, *Zinc, Calcium, Magnesium, *Iron, Sulfur, Chlroine, Manganese, Metals, Chemical analysis, Spectrophotometry, Animal physiology, Animal metabolism, *Tissue analysis, *Bioaccumulation, Glycera.

Analyses of the jaws of the glycerid polychaete Glycera gigantea show that copper is the principal metal component, accounting for about 1.5% of the dry weight and representing up to 67% of the total body burden of copper. The copper is concentrated in the distal tip of the jaw where the concentration is as high as 13%. Other metals in the jaws include zinc, calcium and magnesium which together account for about a further 1% of the dry weight; the iron content is low. Sulphur and chlorine are also present in appreciable quantities. A high copper level is also present in the jaws of G. convoluta, G. lapidum and G. rouxi. Although the copper concentration in the body of G. convoluta may be markedly increased at contaminated sites, the copper concentration in the jaws does not appear to be influenced by the environmental level; evidently a high copper level is a structural feature of the glycerid jaw. Zinc levels in both jaws and bodies remain fairly constant despite wide environmental variations. (Deal-EIS)
W80-04413

MERCURY IN WATER, ORGANISMS AND SEDIMENTS FROM A SECTION OF THE TURKISH MEDITERRANEAN COAST,
Middle East Technical Univ., Ankara (Turkey). Dept. of Marine Sciences.
G. Tuncel, G. Ramelow, and T. I. Balkas.
Marine Pollution Bulletin, Vol 11, p 18-22, 1980, 1 Fig, 7 Tab, 15 Ref.

Descriptors: *Mercury, *Baseline studies, Heavy metals, Water chemistry, Marine fish, Bottom sediments, Chemical analysis, Mullets, Coasts, Industrial wastes, *Mediterranean Sea, *Turkey, *Tissue analysis, *Bioaccumulation.

Samples of water, marine organisms and sediment collected along the Turkish Mediterranean coast in the vicinity of Mersin were analysed for total mercury. The levels of mercury found in the samples from this area are generally low in comparison with the levels found in other regions of the Mediterranean. (Deal-EIS)
W80-04417

CHLORINATED HYDROCARBONS IN FISH-EATING BIRDS FROM THE GDANSK BAY, BALTIC SEA,
Morski Inst., Gdansk (Poland).
R. Dubrawski, and J. Falandysz.
Marine Pollution Bulletin, Vol 11, p 15-18, 1980. 2 Fig, 2 Tab, 20 Ref.

Descriptors: *Pesticide residues, *Water birds, *Chlorinated hydrocarbon pesticides, *Migratory birds, DDT, Polychlorinated biphenyls, Chemical wastes, Industrial wastes, DDD, DDE, Chemical analysis, Gas chromatography, *HCB, *Tissue analysis, *Bioaccumulation.

Chlorinated hydrocarbons in industrial and agricultural use are found at significant concentrations in coastal regions. This paper reveals concentrations of HCB, DDT and PCB in tissues of the fish-eating birds staying at their winter quarters in the South Baltic. The species analyzed were: Great Crested Grebe (Podiceps cristatus); Slavonian Grebe (Podiceps auritus); Black Guillemot (Cepphus grylle); Goosander (Mergus merganser); and, Black-Throated Diver (Garia arctica). The results were compared to other studies on these species. (Deal-EIS)
W80-04419

FACTORS CAUSING ELEVATED BIOLOGICAL OXYGEN DEMAND IN THE LITTORAL ZONE OF LAKE WINGRA, WISCONSIN,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W80-04457

IMPACT OF THE 1977 CLEAN WATER ACT AMENDMENTS ON INDUSTRIAL DISCHARGERS,
Morgan, Lewis and Bockius, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04487

NONPOINT POLLUTION CONTROL IN VIRGINIA,
For primary bibliographic entry see Field 6E.
W80-04500

5C. Effects Of Pollution

AVAILABILITY TO SCENEDESMUS QUADRICAUDA OF DIFFERENT FORMS OF PHOSPHORUS IN SEDIMENTARY MATERIALS FROM THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
J. D. H. Williams, H. Shear, and R. L. Thomas.
Limnology and Oceanography, Vol 25, No 1, p 1-11, January 1980. 2 Fig, 4 Tab, 38 Ref.

Descriptors: *Sediments, *Phosphorus, *Algae, *Lake sediments, *Great Lakes, Suspended solids, Erosion, Bank erosion, Sampling, Laboratory tests, Nutrients, Pollutants, Water pollution, Water pollution effects, Lakes, Limnology.

Sedimentary materials from eroding bluffs, suspended solids in streams, and lake bottom sediments from Lakes Ontario and Erie were cultured with the alga Scenedesmus quadricauda (Turp.) de Brebisson in modified Rodhe's medium with the sediments as the sole source of P. P uptake by the algae was related to the amount of nonapatite inorganic phosphorus in the sediments. Apatite phosphorus was not used, and the bluff samples, in which over 90% of total P was in this form, did not support algal growth. The nonapatite inorganic P fraction was highly correlated with the amounts of inorganic phosphorus extracted by three standard techniques for estimating 'available P' (extraction by NaOH and nitrilotriacetic acid solutions and by H-resin), and cell uptake equaled NaOH-extractable inorganic P in several instances. Uptake of P by the cells varied from 8 to 50% of total P and from 38 to 83% of nonapatite inorganic P when measured directly. Organic phosphorus in the sediments was not utilized by the algae. Percentage utilization of total P was in general highest when total P concentration in the sediments was itself high. (Sims-ISWS)
W80-04253

DISTRIBUTION, FLUXES AND BIOLOGICAL UTILIZATION OF INORGANIC NITROGEN DURING A SPRING BLOOM IN THE NEW YORK BIGHT,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
H. L. Conway, and T. E. Whitledge.
Journal of Marine Research, Vol 37, No 4, p 657-668, November 1979. 4 Fig, 2 Tab, 30 Ref. DOE EY-76-C-02-0016.

Descriptors: *Ammonia, *Nitrates, *Phytoplankton, *New York Bight, *Nitrogen cycle, *Cycling nutrients, Nitrogen, Distribution, Kinetics, Nutrient requirements, Zooplankton, Continental shelf, Ceratium, Biochemistry, Euphotic zone, Light intensity, Physical properties, Bacteria, Pelagic zone, Copepods, Biomass.

Biological processes were important in rapid ammonia regeneration and recycling in the euphotic zone during a Ceratium tripos bloom in the New York Bight, April-May 1976. Inshore phytoplankton communities, typically located at depths > 25 m, are characterized by ammonia (NH4) and nitrate (N03) uptake rates that are less light-dependent than those of more uniformly distributed communities at the shelf break. Ammonia utilization, as a percentage of NH4 plus N03 utilization, yields values of 59% inshore and 70% at the shelf break. Inshore zooplankton have a 1.0 g/sq m mean dry weight whereas near the shelf break copepods have a 7.6 g dwt/sq m mean biomass. Greater zooplankton biomass at the shelf break compared to inshore regions corresponds to increased NH4 utilization by phytoplankton. Estimated NH4 re-

generation rates of inshore and shelf break zooplankton are 0.6 and 6.4 mmol N/sq m d, respectively. Observed NH4 utilization rates are 7.7 inshore and 10.3 mmol N/sq m d at the shelf break. In inshore water, benthic regeneration provides an additional 1.6 mmol N/sq m d and bacterioplankton, 0.65-1.85 mmol N/sq m d. Combined inshore NH4 input provides 38-53% of phytoplankton utilization potential whereas shelf break zooplankton NH4 input alone provides 62% daily regenerated production. Surface ambient NH4 and N03 concentrations are 0.4 and 0.1 micro mol/l, respectively; however, at 25-50 m depths concentrations are 2 and 4 micro mol/l, respectively. The New York Bight is bounded by Long Island on the north, New Jersey on the west and the 100 fathom contour line seaward. (Danovich-Wisconsin)
W80-04274

INFLUENCE OF AMAZON RIVER DISCHARGE ON THE MARINE PRODUCTION SYSTEM OFF BARBADOS, WEST INDIES,
Bellairs Research Inst., St. James (Barbados).
R. Kidd, and F. Sander.
Journal of Marine Research, Vol 37, No 4, p 669-681, November 1979. 1 Fig, 3 Tab, 57 Ref.

Descriptors: *Salinity, *Barbados, West Indies, *Amazon River, *Primary productivity, *Marine microorganisms, Nutrients, Water chemistry, Plankton, Hydrography, Tropical regions, Zooplankton, Speciation, Seasonal, Diatoms, Nutrient transport, Currents(Water), Precipitation(Atmospheric), Discharge(Water), Copepods, Runoff.

Hydrographic, biochemical and biological evidence show that Amazon River discharge has a profound effect on primary production off Barbados, West Indies, monitored February 1975-March 1976. Lower salinities, 33.4 ppt as opposed to 35.4 ppt (winter), traditionally experienced every summer at Barbados is attributed chiefly to increased seasonal precipitation and subsequent increased runoff in the Amazon region. In the tropical Caribbean marine environment, production is restricted by lack of essential nutrients. Phosphate concentrations are statistically higher during summer (0.060 micro g-A/l) than winter (0.043 micro g-A/l). Phytoplankton counts clearly indicate higher average plant populations during summer than winter. Diatoms account for a larger percentage of phytoplankton during summer (79.60%) than winter (54.65%). Mean zooplankton dry weight and numbers are significantly higher in summer than in winter. Twenty copepod species previously unknown to Barbadian waters were recorded; 13 of these occurred in winter and only seven during summer. Lower diversity and sominance are associated with summer Amazon River 'freshened' waters in the region. Conversely, higher diversity and dominance are associated with winter, when Amazon River influence is minimal. Lower salinity waters, associated with maximum Amazon River discharge, increase physiological stress to the otherwise biologically-accommodated stenotopic regional fauna. This favors eurytopic pelagic fauna, reducing species diversity and giving rise to lower dominance diversity. (Danovich-Wisconsin)
W80-04275

CHANGES IN PHOSPHORUS CONCENTRATION IN A EUTROPHIC LAKE AS A RESULT OF MACROPHYTE-KILL FOLLOWING HERBICIDE APPLICATION,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
M. T. Michaud, G. J. Atchison, A. W. McIntosh, R. A. Mayes, and D. W. Nelson.
Hydrobilogia, Vol 66, No 2, p 105-111, October 1979. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Aquatic weed control, *Palestine Lake(IN), *Eutrophication, *Phosphorus, *Diquat, Water pollution effects, Lakes, Shallow water, Potamogeton crispus, Ceratophyllum demersum, Lemna minor, Aphanizomenon flos-aque, Seasonal, Algicides, Macrophytes, Sediments, Water quality, Herbicides, Pondweeds.

Only a relatively small and short-term increase in phosphorus concentration occurred in Lake Palestine, Indiana, shortly after P. crispus die-off resulting from herbicide application in May 1976. Phosphorus concentrations in shallow water sediments decrease during summer; those in deep water sediments increase. Although large increases in phosphorus concentration occurred in late summer, it was not attributed to diquat. Palestine Lake, a small 93-ha highly eutrophic lake located in north central Indiana, has two basins connected by a channel; each consists of a small deep area (7-10 m) that stratifies in summer and a large relatively shallow area that completely circulates. In May 1976 diquat was applied to shallow water areas to control Potamogeton crispus which infests the lake during spring and early summer. Large numbers of Lemna minor (duckweed) appeared within a week after herbicide application; subsequent extensive reduction of macrophyte populations occurred. Three weeks after the application L. minor had decreased, and large stands of Ceratophyllum demersum (coontail) appeared. Increased numbers of L. minor were noted during late July, followed by a large bloom of Aphanizomenon flos-aque in August. Between mid April and early August ten collections of water samples from 20-cm below water surface and 20-cm above sediment bottom at three different shallow water sites were made. In addition, water samples were taken from each of two deep water areas at 2-m intervals. (Harris-Wisconsin)
W80-04276

ISOLATION AND IDENTIFICATION OF PATHOGENIC NAEGLERIA FROM FLORIDA LAKES,
Epidemiology Research Center, Tampa, FL.
F. M. Wellings, P. T. Amuso, S. L. Chang, and A. L. Lewis.
Applied and Environmental Microbiology, Vol 34, No 6, p 661-667, December 1977. 2 Fig, 4 Tab, 10 Ref. EPA R-804375-010.

Descriptors: *Pathogenic bacteria, *Lakes, *Florida, *Freshwater, *Public health, Human pathology, Human diseases, Amoebic meningoencephalitis, Water temperature, Sampling, On-site data collections, Naegleria, Thermal pollution, Overwintering sites, Sediments, Lake sediments, Sediment-water interfaces, Cores.

Pathogenic Naegleria survive the winter in freshwater Florida lake bottom sediments, showing that thermal-discharge pollution of waters does not play a role in maintaining natural pathogenetic Naegleria. Thirty one freshwater lakes in Florida were sampled in 1976 to determine the presence of pathogenetic Naegleria, a causative agent of primary amoebic meningoencephalitis. Twelve of 26 lakes sampled only once yield the amoeba. Three of five lakes sampled routinely reach levels of one amoeba per 25 ml of water tested during hot summer months. As water temperatures decline, isolates are obtained only from lake bottom samples in water depths 7-25 feet. Only the upper 3 in of core sample yield isolates. Freshwater lake temperatures during November and December reach a high of 26C and a low of 16C. Due to the methodology used in collecting bottom samples, actual site of cyst survival is not known. Since all core sample isolations were made from the upper 3 in, survival sites appear to be in surface bottom sediments. Indirect fluorescent-antibody techniques show that the antigenic composition of pathogenetic and non-pathogenetic Naegleria exhibits grown differences. (Harris-Wisconsin)
W80-04277

A STUDY OF THE ROLE OF THE SEAGRASS POSIDONIA AUSTRALIS IN THE CARBON BUDGET OF AN ESTUARY,
Commonwealth Scientific and Industrial Research Organization, North Beach (Australia). Div. of Fisheries and Oceanography.
H. Kirkman, and D. D. Reid.
Aquatic Botany, Vol 7, No 2, p 173-183, October 1979. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Port Hacking(Australia), *Leaves, *Carbon cycle, *Estuarine environments, *Marine algae, *Inlets(Waterways), Standing crops, Plant growth, Growth rates, Organic matter, Grazing, Carbon, Regression analysis, Decomposing organic matter, Degradation(Decomposition), Herbivores, Estuaries, Biomass, Floating plants, Grassed waterways, Posidonia australis, Australia.

Estimated average leaf growth was 2.3 mg C/g dwt d for seagrass Posidonia australis in Port Hacking, Australia, April 1974-September 1975. Estimated losses were 2.6 mg C/g dwt d, of which 48% was dissolved organic carbon (DOC) while grazing by herbivores (3%), leaves floating off (12%) and sinking leaves (37%) accounted for the remaining carbonaceous material lost from seagrass leaves. In summer and autumn, herbivores graze at the rate of 0.08 mg C/g leaf d. A mean of 0.136 g/sq m d or 0.3 mg C/g d of floating seagrass leaves detachs from the seagrass bed; these amounts are only 0.004% per day of the total 500 sq m seagrass bed biomass. Mean accumulation rate of leaf material or sinking particulate organic carbon is 0.45 g/sq m d or 0.96 mg C/g d. DOC release rates by seagrass leaves range 0.744-1.752 mg C/g d; results include excreted material plus DOC given off by leaf decomposition. Leaf growth over the warmer months varies 2.4-2.8 mg C/g d, while for cooler months, figures range 1.4-1.8 mg C/g d. DOC accounts for the greatest organic carbon loss from the system. The study area is part of an estuarine sunken river valley with 18 m maximum depth; the valley is cut by wide, shallow sand sills which support seagrass beds. (Danovich-Wisconsin)
W80-04278

REFLECTANCE SPECTROSCOPY OF MARINE PHYTOPLANKTON. PART I. OPTICAL PROPERTIES AS RELATED TO AGE AND GROWTH RATE,
University of Southern California, Los Angeles. Dept. of Biological Sciences.
D. A. Kiefer, R. J. Olson, and W. H. Wilson.
Limnology and Oceanography, Vol 24, No 4, p 664-672, July 1979. 6 Fig, 2 Tab, 19 Ref. NOAA 04-6-158-44031 and 04-6-158-44033.

Descriptors: *Reflectance, *Marine algae, *Optical properties, *Age, *Growth rates, Cultures, Phytoplankton, Spectrometers, Absorption, Light, Thalassiosira, Monochrysis, Chrysophyta, Oceans, Color, Standing crops, Cytological studies, Chlorophyll, Pigments, Spectrophotometry.

Diffuse spectral transmittance and reflectance measurements from suspensions of diatom Thalassiosira pseudonana (batch cultures) and chrysophyte Monochrysis lutheri (continuous cultures) contain information relating not only to cell concentrations but also to cell age and growth rates. Measurements yield values for the diffuse absorption coefficient, A, and diffuse backscattering coefficient, B, two parameters used to calculate effects of phytoplankton crop size on ocean color spectra. In both experiments, the ratio of absorption coefficient to backscattering coefficient, A:B, decreases with decreasing growth rate or increasing culture age. In batch cultures the ratio A:B decreases with age once the plateau phase is reached; in continuous cultures, A:B is roughly proportional to specific cell growth rates. Thus, in steady state systems, phytoplankton absorption and scattering properties appear to be an index of the growth rate or nutritional state of a given species. In batch cultures, changes in A:B for 450 and 675 nm, corresponding to maximum blue and red absorption by cells, parallels changes in the ratio of cell chlorophyll-a to cell cross section. In the red region of chlorophyll-a absorption, the magnitude of both changes is comparable. Ratio of A:B decreases with increasing age; this is caused predominantly by the loss of photosynthetic pigments however, backscattering efficiency also increases significantly. Changes in A:B are larger at the red absorption maximum of chlorophyll-a than in the blue, where accessory pigments also contribute to the absorption coefficient. (See also W80-04280) (Danovich-Wisconsin)
W80-04279

REFLECTANCE SPECTROSCOPY OF MARINE PHYTOPLANKTON. PART 2. A SIMPLE MODEL OF OCEAN COLOR,

Scripps Institution of Oceanography, La Jolla, CA. Visibility Lab.
W. H. Wilson, and D. A. Kiefer.
Limnology and Oceanography, Vol 24, No 4, p 673-682, July 1979. 6 Fig, 18 Ref. NOAA 04-6-158-44031 and 04-6-158-44033.

Descriptors: *Color, *Phytoplankton, *Reflectance, *Optical properties, *Oceans, Light, Water properties, Absorption, Standing crops, Spectrometers, Growth rates, Age, Equations, Mathematical models, Mathematical studies, Physical properties, Cultures, Sargasso Sea, Diffusion, Atlantic Ocean.

A two-component (water and phytoplankton) model of ocean color is based on measurements of optical properties of phytoplankton grown in the laboratory; broad spectral changes in diffuse reflectance result not only from phytoplankton crop size but also from age or physiological state. The ratio of reflectances at two wavelengths, R (440 nm):R (550 nm), is graphed as a function of chlorophyll concentration for four spectra sets. The relationship between chlorophyll-a concentration and reflectance ratio at these two wavelengths is hyperbolic; reflectance ratios range from a high value, 6, for blue oligotrophic waters where phytoplankton contribute insignificantly to absorption and backscattering, to a low of 0.2 in yellow-green waters where phytoplankton contribute exclusively to total absorption and backscattering. At low chlorophyll concentrations when the ratio is large, it changes rapidly and at high concentrations it changes slowly. Since microscopic examinations of natural seawater generally reveal higher concentrations of brown and white detritus than living cells, older cells are probably more like detritus optically than faster growing cells. Ocean color spectra was compared with field optical measurements. Phytoplankton coefficients were determined from spectrophotometer measurements of cells grown in the laboratory; water coefficients were calculated from optical measurements made in Sargasso Sea oligotrophic waters. (See also W80-04279) (Danovich-Wisconsin)
W80-04280

INTERACTION (ALLELOPATHY) BETWEEN MARINE DIATOMS: THALASSIOSIRA PSEUDONANA AND PHAEODACTYLUM TRICORNUTUM,
Delaware Univ., Lewes. Coll. of Marine Studies.
J. H. Sharp, P. A. Underhill, and D. J. Hughes.
Journal of Phycology, Vol 15, No 4, p 353-362, December 1979. 8 Fig, 3 Tab, 39 Ref.

Descriptors: *Cultures, *Diatoms, *Allelopathy, *Competition, *Inhibition, Growth rates, Phytoplankton, Population, Density, Phaeodactylum, Thalassiosira, Cytological studies, Laboratory tests, Aquiculture, Hydrogen ion concentration, Nutrient requirements, Silicates, Marine algae, Nutrients.

Evidence from single and mixed culture experiments shows that Phaeodactylum tricornutum is capable of inhibiting Thalassiosira pseudonana growth and that the dominance of the former species in uncontrolled mass algal cultures may be partially due to this effect. In two species batch cultures T. pseudonana grows more rapidly than P. tricornutum during the exponential phase; subsequently P. tricornutum continues to grow and becomes more abundant, possibly due to allelophathy. Inhibitory effects are due to filterable chemicals put into the medium from dense stationary phase cultures; chemicals manifest both a lag prior to exponential phase and lower terminal T. pseudonana population densities. The inhibitory chemical appears to be heat labile in that autoclaving removes its effect. The influence of P. tricornutum on T. pseudonana may be partially due to inorganic additions (hydroxyl ions) to the medium. Differential silicate utilization is also a consideration since P. tricornutum lacks a silicate requirement for growth. Inhibition may also be caused by a vitamin B-12 binding factor. At high growth rates P. tricornutum washes out when added at low density, whereas T. pseudonana maintains constant cell density. However, when sufficient P. tricornutum densities are added as a contaminant, both species wash out. At lower growth rates, P. tricornutum increases in density when added and eventually reaches a stable population; T. pseudonana then washes out. (Danovich-Wisconsin)
W80-04281

DIURNAL OXYGEN RHYTHM AND PRIMARY PRODUCTION IN THE MIXED LAYER OF THE ATLANTIC OCEAN AT 20 DEGREES N,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 5A.
W80-04282

DISSOLVED AND PARTICULATE ORGANIC CARBON IN THE NORTH EQUATORIAL CURRENT OF THE ATLANTIC OCEAN,
Nederlands Inst. voor Onderzoek der Zee, Texel.
H. Postma, and J. W. Rommets.
Netherlands Journal of Sea Research, Vol 13, No 1, p 85-98, October 1979. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Carbon cycle, *Atlantic Ocean, *North equatorial current, *Organic matter, *Cycling nutrients, *Primary productivity, Carbon, Surface waters, Carbon dioxide, Diurnal, Nutrients, Nutrient transport, Sinks, Salinity, Chemical properties, Environmental gradient, Upwelling, Mixing, Currents(Water), Water circulation.

In September-October 1977 and November 1978 a study of biological systems in the North Equatorial Current of the Atlantic Ocean, focusing on organic matter cycles in upper surface layers, indicated that POC decreased east to west from an average 100 microg/l to 35 microg/l. POC differences between a day and night are 70-20 microg/l, respectively. From these differences, primary production values of 450-1000 g C/sq m yr were calculated. These values are much higher than earlier data obtained by C14 measurements. Such high productivity in subtropical ocean areas is due to rapid chemical recycling by very small microplankton standing stocks. Chemical components measured also show distinct vertical gradients. DOC decreases with depth from 1 mg/l surface values to 0.5 mg/l at 500 m; carbon dioxide (C02) increases in the same direction, 2.05 mmol/l at the surface and 2.3 mmol/l at 500 m. DOC and C02 are inversely related with a 1:6 ratio. Downward DOC transport calculated from vertical gradients is 8 g/sq m yr. The highest POC concentrations (>100 microg/l) are found in surface waters; the lowest amounts (<20 microg/l) occur in deeper water. Salinity is highest in the upper layers, with values over 36 ppt, and decreases with depth. Upwelling occurs at some stations and is indicated by rising isohalines. A density discontinuity layer is present at 40-75 m. Below this discontinuity layer, a salinity maximum is found; the highest salinity is 37.2 ppt. The salinity maximum represents surface water from the north that has descended below the discontinuity layer and flows south. (Danovich-Wisconsin)
W80-04283

CURRENT C14 METHODS FOR MEASURING PRIMARY PRODUCTION: GROSS UNDERESTIMATES IN OCEANIC WATERS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 5A.
W80-04284

AN INVESTIGATION OF HETEROTROPHIC AND PHOTOHETEROTROPHIC CAPABILITIES IN MARINE PYRRHOPHYTA,
Harvard Univ., Cambridge. Biological Labs.
L. C. Morrill, and A. R. Loeblich, III.
Phycologia, Vol 18, No 4, December 1979, p 394-404. 6 Fig, 1 Tab, 44 Ref. NSF DEB 78 25621.

Descriptors: *Heterotrophy, *Pyrrhophyta, *Dinoflagellates, *Light, *Speciation, *Growth rates, *Nutrient requirements, Biochemistry, Photosynthesis, Cultures, Nitrogen, Organic compounds, Organic matter, Algae, Metabolism, Plant physiology, Plant growth, Substrates, Soils, Laboratory tests, Darkness, Marine algae.

Eight marine dinoflagellates were investigated for possible heterotrophic and photohetrotrophic growth on 54 organic substances; in all but two organisms, the highest or second highest growth rates under photosynthesis limiting conditions occurred with glycerol. Because glycerol concentrations used in experiments are high (54 mM) relative to organic carbon concentrations in seawater, it is doubtful that these compounds play a major role in trophic strategies of marine dinoflagellates. In some organisms in the presence of DCMU, soil extract allows higher growth rates than glycerol. Despite widespread capability of photoheterotrophic glycerol utilization, true heterotrophy does not occur among organisms tested in darkness. When Peridinium foliaceum is tested in glycerol, some cells continue to swim for as long as two weeks. Inability to grow on glycerol in the dark results from the inability to take up glycerol rapidly enough to provide sufficient energy to divide. Dinoflagellates are also sensitive to high glycerol concentrations; the maximum which P. foliaceum tolerates is 250 mM. High glycerol concentrations are inhibitory because of osmotic effects. Soil extracts do not support photoheterotrophic growth in any organism tested under dim light. Nitrogen limited cultures of P. foliaceum and free-living Zooxanthella microadriatica are capable of using soil extract as a nitrogen source. Other species tested include Cachonina niei, P. balticum, symbiotic Z. microadriatica, Amphidinium carterae, Fragilidium heterolobum and a second isolate of P. foliaceum. (Danovich-Wisconsin)
W80-04285

DESCRIPTIVE AND COMPARATIVE STUDIES OF MAINE LAKES,
Maine Univ. at Orono. Life Sciences and Agriculture Experiment Station.
For primary bibliographic entry see Field 2H.
W80-04286

INTEGRATION OF BIOLOGICAL WITH THERMAL CRITERIA FOR POWER PLANT DESIGN AND WATER RESOURCE USE,
Wisconsin Univ.-Madison. Lab. of Limnology.
J. J. Magnuson, P. A. Medvick, G. W. Gallepp, R. J. Hall, and P. W. Rasmussen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-166440, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin Technical Completion Report 80-02, 1979. 52 p, 13 Fig, 3 Tab, 26 Ref. OWRT B-092-WIS(1), 14-31-0001-5133.

Descriptors: *Sunfishes, Freshwater fish, Fish behavior, Food habits, Fish diets, Fish parasites, *Fish populations, *Growth rates, *Heated water, Electric power plants, Cooling water, Water temperature, Lakes, Lake Monona(WI), Dane County(WI), Wisconsin, *Thermal power plants, Environmental effects, *Bluegill.

The energetic consequences of heated effluent from a 220 MW generating plant on the growth and production of bluegill in a 1400 ha eutrophic lake were analyzed. The heated effluent altered temperatures of 1-2% of the lake surface area or 2.6% of its littoral zone. Average temperatures in the outfall area did not exceed 30C. During summer an average of 6-7% of the bluegill in the lake were estimated to be in the outfall area. In winter bluegill released near the outfall tended to remain in the heated water and remained closer to shore than in other seasons. Growth of bluegill was compared between the outfall and reference area from measurements of fish held in each area in enclosures, and from growth simulation using a bioenergetic model for fish growth. Fish in cages usually grew more rapidly in the outfall, but simulated growth was slightly lower in the outfall area. A strong argument cannot be made for major effects of the heated effluent on growth. Based on the observed growth of caged fish and high population density in the outfall area, small bluegill in the littoral zone may have a 20% enhancement of production during summer. The results indicate that a small electric generating station in an urban area can use the local eutrophic lake as a source of once-through cooling water without negative effects on the growth and production of the dominant warmwater fishes. (Warner-Wis)

W80-04289

METHANE ADDITION TO AN ARCTIC LAKE IN WINTER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W80-04308

THE ACUTE TOXICITY OF ELEVEN DETERGENTS TO FISH: RESULTS OF AN INTERLABORATORY EXERCISE,
Shell Research Ltd., Sittingbourne (England). Toxicology Lab.
B. Reiff, R. Lloyd, M. J. How, D. Brown, and J. S. Alabaster.
Water Research, Vol 13, No 2, p 207-210, 1979. 4 Tab, 12 Ref.

Descriptors: *Toxicity, *Fish, *Detergents, *United Kingdom, *Germany, Toxins, Water quality, Water quality standards, Speciation, Testing, Testing procedures, Laboratory tests, Lethal limit, Pollutants, Water pollution effects, Water pollution, Fish types, Fish physiology, Brown trout.

Results from a 1973 interlaboratory ring test to assess acute toxicity of 11 detergents to fish in the United Kingdom and Germany demonstrate that a reliable order of magnitude for acute toxicity is obtained by a variety of test fish and procedures. The golden orfe (Idus idus melanotus) was tested in Germany and harlequin fish (Rasbora heteromorpha) and rainbow trout (Salmo gairdneri) were tested in the United Kingdom. German tests use only one standard method while the United Kingdom series employs six different methods. LC50 values for each detergent obtained by various methods and fish species are all within the same order of magnitude. When considering the average 48-h LC50 values, brown trout tends to yield lower values than other species and taken overall, the golden orfe and harlequin fish have approximately the same sensitivity towards detergents. Both German and U.K. tests rank detergents 10, 4, 1 and 6 as least toxic and detergents 5, 9 and 3 as most toxic. Acute toxicity tests cannot be used alone in setting water quality standards but only in conjunction with other data such as biological and chemical oxygen demand, biodegradability, compound amounts likely to reach surface waters, uptake and metabolism by aquatic organisms, longer lethal and sublethal effects, together with receiving water chemical and physical characteristics. Products resulting from biodegradation should also be tested for acute toxicity. (Danovich-Wisconsin)
W80-04341

THE INFLUENCE OF THICK FLOATING VEGETATION (WATER HYACINTH: EICHHORNIA CRASSIPES) ON THE PHYSICO-CHEMICAL ENVIRONMENT OF A FRESH WATER WETLAND,
Bhagalpur Univ. (India). Ecology Research Lab.
D. N. Rai, and J. D. Munshi.
Hydrobiologia, Vol 62, No 1, p 65-69, January 1979. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Bhathwa Pokhar, India, *Water hyacinth, *Wetlands, *Physicochemical properties, *Freshwater marshes, Swamps, Sewage disposal, Hydrogen ion concentration, Dissolved oxygen, Carbon dioxide, Seasonal, Environmental effects, Ecosystems, Ecology, Floating plants, Aquatic weeds, Aquatic plants, Diurnal, Water temperature.

Physiochemical measurements December 1976-August 1977 of Bhathwa Pokhar, a freshwater wetland at Darbhanga, India, showed that dissolved carbon dioxide was higher and that oxygen, pH and temperature fluctuations were lower under water hyacinth areas than in open water. The extent of difference depends on the time of day and season. Due to extreme hypercarbic and hypoxic conditions most vertebrates living in hyacinth infested areas are air breathers such as water snakes and turtles or supplemental air breathers such as frogs and air-breathing fish. High carbon dioxide and low oxygen concentrations are due to high anaerobic decomposing mat leaves and detritus, increased respiratory activities of organisms, and decreased photosynthetic rates caused by water hyacinth shadowing effects over the water surface. Oxygen is very low under water hyacinth mats (always less than 2 ppm) and during the summer oxygen levels are reduced to zero in both infested and uninfested water areas. Dissolved oxygen reaches its lowest value in late night hours (4 A.M.) and peaks in the afternoon; the maximum value is 7 ppm in clear areas during winter. Bhathwa Pokhar is a shallow (1.5 m mean depth), small (1.5 ha), swampy pond and 98% area is covered by water hyacinth. The source of pond water is Darbhange Medical College campus sewage. (Danovich-Wisconsin)
W80-04342

PHOSPHORUS IN A MODEL POND STUDY: I SEDIMENT SELECTION AND PREPARATION,
Science and Education Administration, Durant, OK. Water Quality Management Lab.
A. Olness, W. W. Troeger, G. D. Pardue, and R. R. Huckleberry.
Hydrobiologia, Vol 63, No 1, p 11-15, March 1979. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Soil chemistry, *Soil types, *Fertilizers, *Phosphorus, *Adsorption, *Sediments, Soil properties, Soil erosion, Soil texture, Soils, Nutrients, Phosphates, Erosion, Ponds, Water pollution sources, Nutrient removal, Fertilization, Chemical properties, Loam.

Test results on two surface soils with contrasting textures show that any soil fertilizer additions increase the equilibration concentrations of soil suspensions and that erosion of fertilized soil increases phosphorus concentrations in reservoirs; however, due to buffering the increase in equilibrium phosphorus concentrations is not proportional to fertilizer phosphorus additions. Transformations of adsorbed phosphorus to fixed or non-exchangeable forms occurs more rapidly in some soils and further reduces fertilization effects. Soils tested included San Saba clay and Bowie loam. San Saba soil contains three times as much clay (45%), six times as much total phosphorus (415 micro g/g), four times as much inorganic phosphorus (225 micro g/g) and over three times as much organic carbon (3.5%) compared with Bowie soil. Both have near-neutral pH. San Saba soil contains significant amounts of carbonate (4.2%) whereas Bowie soil is virtually carbonate free. Phosphorus adsorption limits obtained with Langmuir adsorption model are > 200 micro g/g and 50 micro g/g for San Saba and Bowie soils, respectively. Phosphorus adsorption is proportional to soil surface area and clay content. San Saba soil has a larger buffering capacity and browder buffering range than Bowie soil. Significant phosphate fixation takes place in clay soil but no fixation occurs in loam soil. (Danovich-Wisconsin)
W80-04343

DENITRIFICATION BY THE SESSILE MICROBIAL COMMUNITY OF A POLLUTED RIVER,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
T. Nakajima.
Hydrobiologia, Vol 66, No 1, p 57-64, September 1979. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Denitrification, *Sessile algae, *Tamagawa River, Japan, *Water pollution effects, Nitrogen, Sewage effluents, Microorganisms, Water pollution, Tracers, Water temperature, Municipal wastes, Gases, Laboratory tests, Ammonia, Bacteria, Nitrates, Nitrites, Rivers, Metabolism, Plant physiology.

Denitrification by the sessile microbial community in the Tamagawa River, Japan is demonstrated by data collected 1974-1977. Loss of total inorganic nitrogen (sum of ammonia-, nitrite-, and nitrate-nitrogen) was observed when river water was incubated with sessile microorganisms in an artificial stream. In very polluted water areas, the loss was 1 mg N/1/d. This loss is due to inorganic nitrogen assimilation by sessile microbes and denitrifying bacteria which numbered 10 million cells/sq cm. Denitrification is confirmed by using N15 as a tracer. Dinitrogen evolved from labeled nitrate for both sessile microbial communities taken from unpolluted and polluted areas, even though they were incubated with oxygenated river water. The denitrification rate by sessile microbial communities taken from a very polluted area is 8-16 mg N/sq m/d and rises to 74-230 mg N/sq m/d when water temperatures increase from 14 to 30C. The N2 Ar ratio of gases evolved from the river bed is higher than that of air, suggesting in-situ denitrification. The Tamagawa River is located in the southwest part of Tokyo and is heavily polluted with municipal sewage. (Danovich-Wisconsin)
W80-04345

DIVERSITY AND INDICATOR SPECIES AS MEASURES OF WATER POLLUTION IN A SUBARCTIC LAKE,
J. W. Moore.
Hydrobiologia, Vol 66, No 1, p 73-80, September 1979. 4 Fig, 36 Ref.

Descriptors: *Speciation, *Water pollution, *Population, *Heavy metals, *Great Slave Lake(Canada), *Bioindicators, Mine wastes, Mineral industry, Indicators, Benthic fauna, Subarctic, Yellowknife Bay(Canada), Pollutant identification, Environmental effects, Invertebrates, Chironomidae, Mollusks, Effluents, Waste water(Pollution), Density, Canada.

Diversity indices and indicator species are ineffective in monitoring heavy metal pollution in Yellowknife Bay, situated on the north shore of Great Slave Lake, Northwest Territories, Canada, June-September 1976; however, density estimates provide a better assessment of subarctic pollution. The density of benthic organisms averages 100 animals/sq m near the effluent discharge point. At 1.5 km east and south of the discharge point, density reaches 1,000 animals/sq m. A total of 25 benthic invertebrates species occur within the most heavily impacted zone (100 animals/sq m). Procladius denticulatus is most abundant (18-30%), followed by Heterotrissocladius changi (12-21%) and Pisidium casertanum (9-15%). In moderately polluted areas (100-1,000 animals/sq m), 25 species occur; 22 of these are also found in the most heavily polluted area. H. changi is most important (18-33%), followed by P. denticulatus (11-20%) and P. casertanum (4-11%). In minimally impacted areas (1,000 animals/sq m), 23 species are found; 18 of these also occur near the effluent discharge point. H. changi accounts for 11-29% of benthic community numbers. Results show that in subarctic areas, diversity index does not monitor water pollution. Total species numbers are similar in all three impact areas. Moreover, percentage contribution of dominant community species are comparable throughout the study area. Sediments near the mine discharge contain high heavy metal concentrations: arsenic (2,500 mg/kg dwt); mercury (500 micro g/kg); lead (850 mg/kg); copper (750 mg/kg) and zinc (950 mg/kg). (Danovich-Wisconsin)
W80-04346

DISTRIBUTION AND ABUNDANCE OF ATTACHED, LITTORAL ALGAE IN 21 LAKES AND STREAMS IN THE NORTHWEST TERRITORIES,
J. W. Moore.
Canadian Journal of Botany, Vol 57, No 6, p 568-577, March 1979. 4 Fig, 3 Tab, 46 Ref.

Descriptors: *Sessile algae, *Northwest territories(Canada), *Lakes, *Streams, *Baseline studies, Aquatic plants, Epilithic, Epiphytes, Yellowknife(Canada), Great Slave Lake(Canada), Great Bear Lake(Canada), On-site data collection, Algae, Plant populations, Distribution, Littoral, Sediments, Sands, Substrates, Density, Biomass, Canada.

Four types of sessile, littoral algae were collected from 18 lakes and three streams in an area directly north-northeast of Yellowknife, Canadian Northwest Territories. Collections of algae attached to

rocks (epilithic), sediments (epipelic), higher plants (epiphytic) and sand grains (epipsammic) were made during 1975-1976 to determine population species composition and density. Tabellaria flocculosa is dominant among epilithic and epipelic species, with maximum density of 50-250 million cu micro m/sq cm. Of secondary importance are Achnanthes minutissima, Navicula spp., and Nitzschia frustulum, at densities of 10-30 million cu micro m/sq cm. The only two common epiphytic taxa, A. minutissima and T. flocculosa, maintain populations of 100-130 million cu micro m/sq cm; the most common epipsammic species (Amphora ovalis, Fragilaria construens, Achnanthes minutissima and A. pinnata) reach maxima of 4 million cu micro m/sq cm. For all sessile algae studied, the growing season is June -October. All four algal types have unimodal growth, reaching maximum in either July or August. Growing season stops in mid-October with freezeover of lakes and rivers. All lake samples were collected from the shoreline in less than 1 m of water. Collections in the three streams were made in still-water pools midstream, also at less than 1 m depth. (Harris-Wisconsin)
W80-04347

SALINITY INFLUENCE ON THE ECOLOGY OF PHYTOFLAGELLATE BLOOMS IN LOWER NEW YORK BAY AND ADJACENT WATERS,

National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab.
J. B. Mahoney, and J. J. A. McLaughlin.
Journal of Experimental Marine Biology and Ecology, Vol 37, No 3, p 213-223, March 1979. 2 Fig, 1 Tab, 16 Ref. EPA R 803370030.

Descriptors: *Saline water-freshwater interfaces, *New York Bright, *Salt tolerance, *Marine algae, Estuaries, Saline water intrusion, Estuarine environments, Eutrophication, Olisthodiscus luteus, Massartia rotundata, Prorocentrum micans, Dinoflagellates, Phytoflagellates, Stress, Stress analysis, Laboratory tests, Cultures, Ecology, Growth rates, Salinity, *Lower New York Bay.

Salinity tolerances of phytoflagellates dominant in Lower New York Bay blooms are examined, with particular attention to possible river-ocean transition effects. Salinities in these waters range 15-32%. Cultures of Olisthodiscus luteus, Massartia rotundata and Prorocentrum micans were isolated and grown under laboratory simulation of change from brackish-river to ocean water salinities. Massartia grows well in the 20-33% salinity with optimum at 24-30%, and does not grow at salinities < 14% or > 40%. With preconditioning at 30%, the favorable salinity range shifts slightly higher (21-36%); but, optimum range is nearly the same. Lowest tolerated salinity is again 14% but growth is comparatively reduced up to 16%. Salinities higher than 40% permit growth. Olisthodiscus grows well in 6-42% salinity when preconditioned at 20%, and at 6-46% when preconditioned at 30%. Optimal ranges are wider and higher than for Massartia (10-36%) with no significant shift from inocula preconditioning. In higher salinities, growth of the two inocula is approximately the same except for 46%, at which only the 30% salinity inoculum grows. Prorocentrum preconditioned at 20% has good growth in 18-38% salinity, with optimum growth between 20-36% salinity; lower tolerance level is 6%. Preconditioning at 30% causes this species to grow well at salinities of 20% and higher, but the optimum range shifts to 27-46%, and the lower tolerance limit is high at 10%. Independent of culture preconditioning, optimum salinities are 27-36%. It is speculated that salinity stress may temporarily affect development of Massartia and Olisthodiscus blooms. (Harris-Wisconsin)
W80-04351

ABUNDANCE, POPULATION DYNAMICS AND PRODUCTION OF ZOOBENTHOS IN LAKE MYVATN, ICELAND,

Copenhagen Univ. (Denmark). Freshwater Biological Lab.
C. Lindegaard, and P. M. Jonasson.
Oikos, Vol 32, No 1-2, p 202-227, 1979. 13 Fig, 24 Tab, 41 Ref.

Descriptors: *Lake Myvatn(Iceland), *Baseline studies, *Benthic fauna, *Secondary productivity, Iceland, Aquatic microorganisms, Benthic flora, Tanytarsus gracilentus holmgren, Chironomus islandicus keiffer, Tubifex tubifex muller, Sampling, Food chains, Subarctic, Lakes, Polar regions, Cold regions.

Lake Myvatn is a large (38 sq km), shallow (maximal depth 4 m) northeastern Icelandic lake with an irregular shoreline and some 30 islands. The macrozoobenthos was sampled from depths of 1.5 and 4 m at six stations during 1972-1974, and at one station during 1975-1976. The sampling has produced evidence of 20 macrozoobenthic species. The macrozoobenthic distribution averages 64,500 individuals/sq m. Three species are the most common: Tanytarsus gracilentus Holmgren (79.4%), Chironomus islandicus Keiffer (9.3%), and Tubifex tubifex Muller (7.2%). The relative abundances of T. gracilentus and C. islandicus can be explained in terms of their respective annual life-cycles. T. gracilentus has two generations in one year and therefore it is more common than C. islandicus which has a two year life-cycle. During 1972-1974, the mean annual production of the total benthos community was 28.4 g/sq m, or about 1,000 tons ash free dry weight for the whole lake. T. gracilentus, C. islandicus, and T. tubifex contribute 67.1%, 23.6%, and 2.7% respectively, to total benthos production. Large annual fluctuations in production occurred during 1972-1974. These were traced to fluctuations of C. islandicus and T. gracilentus. In 1975-1976, both species disappeared from the only station where the sampling was conducted during that period. It is not certain if their disappearance is applicable to the whole lake. (Harris-Wisconsin)
W80-04352

NOTES ON THE GROWTH AND SPORULATION OF A NATURAL POPULATION OF APHANIZOMENON FLOS-AQUAE,

New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
R. I. Jones.
Hydrobiologia, Vol 62, No 1, p 55-58, January 1979. 1 Fig, 16 Ref.

Descriptors: *Cyanophyta, *Lough Neagh(Northern Ireland), *Spores, *Germination, *Life history studies, Phytoplankton, Algae, Eutrophication, Population, Population dynamics, Nitrates, Nitrogen, Hydrogen ion concentration, Density, Growth rates, Nutrients, On-site investigations, Northern Ireland.

Observed Aphanizomenon flos-aquae sporulation in 1973 in Kinnego Bay, a highly eutrophic part of Lough Neagh, North Ireland, was probably induced by high pH values caused by dense phytoplankton crops; other measured environmental factors were favorable to Aphanizomenon growth at this time. Aphanizomenon growth was observed in 1973-1974. Sporulation activity occurred only in June, 1973. Exponential growth continued well after sporulation and two secondary growths produced smaller populations than the first, but akinete production was not observed. Akinete production was not observed in 1974; Aphanizomenon growth was slight due to unfavorable conditions for nitrogen-fixing blue-green algae. Algal growth is related to dissolved nitrate-nitrogen in the water. Surficial algal accumulations were not observed in Kinnego Bay; the shallow (mean depth 2.1 m) water column is well mixed at all times. However, in June 1973, Aphanizomenon population density was the highest recorded (8.6 cu mm/l or 7,600 filaments/ml). High densities of photosynthesizing algae can greatly deplete dissolved carbon dioxide levels, leading to high pH values. When akinetes were produced, pH was 9.33-9.61. (Danovich-Wisconsin)
W80-04353

THE LAKE MYVATN ECOSYSTEM, ICELAND,

Copenhagen Univ. (Denmark). Freshwater Biological Lab.
P. M. Jonasson.
Oikos, Vol 32, No 1-2, p 289-305, 1979. 5 Fig, 8 Tab, 70 Ref.

Descriptors: *Lake Myvatn(Iceland), *Reviews, *Baseline studies, *Water quality, Iceland, Bibliographies, Subarctic, Lakes, Polar regions, Cold regions, Water temperature, Trophic level, Lake morphometry, Shallow water, Solar radiation, Rainfall intensity, Primary productivity, Diatoms, Phytoplankton, Benthos, Zooplankton.

The literature on the current physical, chemical, and biological conditions in Lake Myvatn is reviewed. Lake Myvatn, a shallow productive subarctic lake in the northeastern part of Iceland, consists of two basins connected by a narrow stretch of water. The lake bottom contains a layer of diatoms several meters thick and partially covered by macrophytes in the northern basin, and by Cladophora aegagropila in the southern basin. The lake has a phytoplankton production of 118 g C/sq m/year in the southern basin, and 75 g C/sq m/year in the northern basin, which is unusually high for the latitude. Seasonal succession is unimodal. High production due to Anabaena flos-aque coincides with high solar radiation, high temperature and time of ice-break. At other seasons production is low despite considerable biomass of diatoms and chrysophyceans. Net production of benthic diatoms amounts to 2220 kcal/sq m/year. Calculated production of C. aegagropila is 500 kcal/sq m/year. Macroepiphytes and epiphytes are important in the northern basin. A living substratum of Cladophora and macrophytes stabilizes the sediment and acts as sieve for resuspended organic matter. Substrate type and zoobenthos abundance and production show close relationship. Benthic crustacea produce 10 kcal/sq m/year in both basins. Zooplankton produced 43 and 15 kcal/sq m/year in the southern and northern basins respectively. Fish produced 3 kcal/sq m/year, and ducks produced 0.5 kcal/sq m/year, thus suggesting that energy flow is mainly channeled through phytobenthos and zoobenthos. (Harris-Wisconsin)
W80-04354

THE RATES OF DRY MATTER AND NUTRIENT LOSS FROM DECOMPOSING POTAMOGETON PECTINATUS IN A BRACKISH SOUTH-TEMPERATE COASTAL LAKE,

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
C. Howard-Williams, and B. R. Davies.
Freshwater Biology, Vol 9, No 1, p 13-21, February 1979. 3 Fig, 2 Tab, 36 Ref.

Descriptors: *Decomposing organic matter, *Ecology, *Submerged plants, *Lakes, *Swartvlei Lake(South Africa), Detritus, Potamogeton pectinatus, Sago pondweed, Aquatic microorganisms, Nitrogen, Phosphorus, Potassium, Food chains, Littoral areas, Benthos, Shallow water, Benthic flora, Benthic fauna, Macrophytes, Biodegradation, Degradation(Decomposition), South Africa.

The rate of decomposition of the macrophyte Potamogeton pectinatus was studied in Swartvlei, a brackish south-terperate African Lake, during summer 1976, to asscertain the role of macrophytes in lake systems. Fifty litter bags were filled with 15 g of Potamogeton shoots (dry weight) collected prior to shoot die-off. Litter bags allowed the passage of macroinvertebrates which may play an important role in the breakdown process. Bags were suspended just below the surface within the Potamogeton community in two series; one at 2 m depth and the other at 1 m depth. Five bags from each series were harvested at 7, 15, 30, 90, 128, and 158 days. Contents were dried and analyzed for ash, phosphorus, potassium and nitrogen. Overall decay follows an exponential curve. The rate constant is 0.0205 per day. After 158 days, less than 5% of the original dry weight remained in the litter bags of both shallow water and deep-water series. There was no difference in changes of ash, nitrogen, phosphorus and potassium percentages between shallow water and deep water samples. The original stock of ash, phosphorus and potassium was lost more rapidly than dry matter in initial decomposition stages due to leaching. Almost the entire stock of potassium and 60% of phosphorus was lost in the first seven days. However, at 90 days phosphorus levels in the decomposing detritus rose significantly. Nitrogen levels in detritus decomposed slowly throughout the first

90 days and then remained constant. The significance of the decomposition rate of P. Pectinatus is discussed in terms of the Swartvlei Lake ecology. (Harris-Wisconsin)
W80-04355

INORGANIC MINERAL NUTRIENT LEVEL STUDIES ON POTAMOGETON PECTINATUS L. AND ENTEROMORPHA PROLIFERA IN FORFAR LOCH, SCOTLAND,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
Y. B. Ho.
Hydrobiologia, Vol 62, No 1, p 7-15, January 1979. 2 Fig, 5 Tab, 40 Ref.

Descriptors: *Pondweeds, *Forfar Loch(Scotland), *Plant tissues, *Inorganic compounds, *Water chemistry, *Nutrients, Macrophytes, Aquatic plants, Plant physiology, Sodium, Chemical analysis, Biochemistry, Sewage effluents, Correlation analysis, Nitrogen, Phosphorus, Calcium, Potassium, Scotland.

Nutrient levels present in the pondweeds Potamogeton pectinatus and Enteromorpha prolifera during summer 1976 in Forfar Loch, Scotland were generally high, reflecting high nutrient levels in loch waters. Nutrient levels in both Potamogeton and Enteromorpha are well above critical concentrations, reaching averages of 50 mg dwt/g nitrogen (N) and 6 mg dwt/g phosphorus (P). Nutrient levels in Forfar Loch waters are not limiting even at the height of the growing season. Potamogeton tissue N positively correlates ($r=0.805$) with water inorganic N level; tissue P also correlates ($r=0.941$) with phosphate water contents. N levels in Enteromorpha do not correlate with N water contents; the same is true for P. Calcium (Ca) content in Potamogeton ($r=-0.649$) and Enteromorpha ($r=-0.763$) negatively correlates with loch water Ca levels, mainly due to Ca precipitation from water onto the plant surface during high photosynthetic activities coupled with high water pH levels. Potassium (K) levels in Enteromorpha negatively correlate ($r=-0.439$) with K levels in loch water. No correlation is detected for sodium (Na) in both Forfar plants. Overall N and P levels are high and similar; Potamogeton N levels vary 40.4-60.1 mg/g, P levels vary 4.62-8.09 mg/g, Enteromorpha N levels vary 49.4-52.6 mg/g, P levels vary 5.08-7.54 mg/g. Enteromorpha has greater ash content and Ca and Mg levels than Potamogeton, however, the reverse is true for K, Na, and Fe levels. Potamogeton has ten times more sodium than Enteromorpha. (Danovich-Wisconsin)
W80-04356

OUTDOOR ALGAL MASS CULTURES-II. PHOTOSYNTHETIC YIELD LIMITATIONS,
Woods Hole Oceanographic Institution, MA.
J. C. Goldman.
Water Research, Vol 13, No 2, p 119-136, 1979. 14 Fig, 1 Tab, 74 Ref. DOE EG-77-S-02-4151.

Descriptors: *Algae, *Cultures, *Photosynthesis, *Light intensity, *Growth rates, Biomass, Nutrients, Temperature, Limiting factors, Depth, Flow, Flow characteristics, Light, Primary productivity, Algal growth potential, Aquiculture, Curves, Equations, Mathematical models, Physics.

At best conversion efficiencies of total sunlight, theoretical models predict and actual data reveal that 30-40 g dwt/sq m d algal biomass in outdoor cultures can be obtained in the short-term. On a bioengineering basis, the major challenge is to design large-scale outdoor cultures so as to achieve maximum potential yields consistently as a function of available sunlight intensity. Consideration must be given not only to flow rate and depth which control light utilization efficiencies, but also to many other factors affecting algal growth such as mixing, temperature, nutrient supply, pH control, and predator control. Although algal growth rates increase with temperature, respiratory and other decay processes are also influenced. The net effect is that temperature is not nearly as important as sunlight in controlling productivity. Maximal algal yields attained in various locations with different species and growth systems consistently have been 30-40 g dwt/sq m d. Based on productivity curves, 30-40 g dwt/sq m d represents an upper limit in achievable productivity; this figure is also consistent with energy balance curves. Energy balance curves are based on the most liberal considerations including the Bush equation, no decay and no light inhibition. (Danovich-Wisconsin).
W80-04358

A STATISTICAL MODEL FOR SMALL LAKE WATER QUALITY MANAGEMENT,
De Paul Univ., Chicago, IL.
J. Ciecka, R. Fabian, and D. Merilatt.
Water Resources Bulletin, Vol 15, No 5, p 1318-1330, October 1979. 2 Fig, 2 Tab, 12 Ref, 1 Append.

Descriptors: *Eutrophication, *Lakes, *Vollenweider models, *Phosphorus, *Water quality, *Statistical models, Trophic level, Nutrients, Nutrient loading, Lake restoration, Statistics, Regulation, Water quality standards, Decision making, Curves, Equations, Illinois, Recreation, Priorities.

Statistical analysis based on an estimated discriminant function provides support for the hypothesis that Vollenweider models can be applied validly to relatively shallow, fast-flushing lakes. The statistical model extends the Vollenweider and Dillon results by associating each alternative phosphorus loading with a probability that a given lake can achieve or maintain noneutrophic status. Data were initially taken from 27 eutrophic Illinois lakes; the sample size was enlarged to include additional lakes from New York, New England and the Great Lakes states resulting in a sample of 195 lakes, 35 of which were noneutrophic. On the basis of minimal limnological information, together with knowledge of point and nonpoint phosphorus contributions and technological data on nutrient control, quantitative supply priorities can be developed. Application of the model to several Illinois lakes indicates a wide tolerance range for phosphorus intrusion, suggesting that uniform phosphorus standards are not a desirable approach for regulatory agencies to pursue. Maximization of net present expenditures on water quality requires an approach capable of utilizing information provided by Vollenweider's model. The discriminant function provides an important component in a complete cost-benefit analysis of small lake water quality management. The paper concludes with a comparison of the Vollenweider approach to that of Reckhow, who developed a function capable of predicting lake anoxic or oxic conditions; results of both approaches are complimentary. (Danovich-Wisconsin)
W80-04359

NITROGEN FIXATION IN A NITROGEN-LIMITED IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
P. J. Ashton.
Journal of the Water Pollution Control Federation, Vol 51, No 3, p 570-579, March 1979. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Nitrogen fixation, *Impoundments, *Eutrophication, *Water quality control, *Rietvlei Dam(South Africa), Pretoria(South Africa), Nitrogen cycle, South Africa, Reservoirs, Cyanophyta, Anabaena circinalis, Microcystis aeriginosa, Monitoring, Potable water, Kempton Park(South Africa), Phosphorus, Trophic level, Waste water(Pollution), Water pollution effects, Algae, Limiting factors, Eutrophication, Algal blooms.

Water temperature is the major factor regulating the duration of algal blooms. Rietvlei Dam, a warm monomictic lake near Pretoria, South Africa. The dam is a source of potable water for Pretoria and is highly eutrophic; Rietvlei receives secondary treated domestic and industrial wastewater effluents by way of the lake's main feeder stream. The study was initiated October 1975 when a large bloom of Anabaena circinalis Rabenhorst, a heterocystous nitrogen-fixing blue-green alga, occurred in the impoundments. On the basis of two 12-hr field studies and routine monitoring, the total amount of nitrogen fixed by the bloom of A. circinalis October 22 - December 17, 1975 is estimated at 1.13 metric tons. On an annual basis, nitrogen fixed by this alga is approximately equivalent to 19.4% of the loading from the feeder stream. A large portion of the fixed nitrogen is released after the death of the Anabaena cells and becomes available to other species, notable Microcystis aeriginosa. The magnitude of algal blooms of species other than A. circinalis in Rietvlei Dam depends on the supply of available nitrogen in the water phase, inasmuch as this is the primary growth limiting nutrient. Control of the phosphorus in put is considered a key factor to prevent algal growth problems in Rietvlei. (Harris-Wisconsin)
W80-04360

THE SEASONAL CYCLE OF THE PHYTOPLANKTON IN THE COASTAL WATERS OF GHANA,
Fisheries Research Unit, Tema (Ghana).
E. R. Anang.
Hydrobiologia, Vol 62, No 1, p 33-45, January 8, 1979. 13 Fig, 39 Ref.

Descriptors: *Ghana, *Seasonal, *Upwelling, *Phytoplankton, *Tropical regions, *Population dynamics, Marine algae, Atlantic Ocean, Littoral, Diatoms, Water temperature, Salinity, Nitrates, Phosphates, Silicates, Cycling nutrients, Nutrients, Correlation analysis, Coasts, Population, Physicochemical properties.

A study was made to determine seasonal changes in quality and quantity of Ghana offshore phytoplankton population and to relate such changes to physico-chemical factors such as temperature, salinity, and nutrients. Phytoplankton peak numbers correlate well with low nutrient levels during upwelling, with an inverse relationship during other times. Nutrient release takes place rapidly with disappearance of the bloom. Ghana, with a subequatorial climate, experiences major upwelling in coastal Atlantic waters in July-October and minor upwelling in December-January. The major upwelling season is characterized by lowest surface water temperatures (<25C), highest salinity (>35%), and high nutrient concentrations. The minor upwelling period brings a small temperature decrease and an increase in salinity and nutrient concentration. Other times of the year are marked by high surface water temperatures, low salinity and low nutrient concentrations. Phytoplankton cell counts are also seasonal, with values greater than 1 million cells/l during major upwelling and a small increase during minor upwelling. Dinoflagellates almost disappear during both upwelling periods. Diatoms dominate most of the year and constitute more than 90% of the phytoplankton cell counts during major upwelling. Cell numbers and concentrations of nitrate, phosphate and silicate fluctuate, especially during upwelling. (Harris-Wisconsin)
W80-04361

OCCURRENCE OF NITRIC AND NITROUS OXIDES IN A COASTAL MARINE SEDIMENT,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2K.
W80-04362

DYNAMICS AND SUCCESSION OF THE PHYTOPLANKTON IN A TROPICAL LAKE: LAKE LANAO, PHILLIPINES,
Colorado Univ., Boulder. Dept. of Environmental, Population and Organismic Biology.
W. M. Lewis, Jr.
The Journal of Ecology, Vol 66, No 3, p 849-880, November 1978. 12 Fig, 2 Tab, 57 Ref. NSF GB 16054 and GB 41293.

Descriptors: *Phytoplankton, *Succession, *Plant populations, *Environmental gradient, *Lake Lanao(Philippines), Biomass, Nutrient requirements, Tropical regions, Temperate, Cyanophyta, Dinoflagellates, Aquatic microorganisms, Grazing, Light intensity, Sinking rate, Diatoms, Cryptomonads, Algae, Philippines.

At tropical lake Lanao, Philippines, analysis of growth fluctuations and growth correlations in the major phytoplankton classes provides evidence that the niche space divides in response to nutrient and light availability. Weekly abundance measurements were made of 70 phytoplankton species August, 1970- October, 1971. Maximal growth in diatoms and cryptomondas occurs during low light and high nutrient availability. Growth maxima for green algae, blue-green algae and dinoflagellates occur successively toward the high light and low nutrient end of the spectrum. Placement of species in terms of their growth responding to light availability and nutrient availability gradients creates a taxonomic pattern similiar to that observed in the class-level analysis of succession. Grazing rate and sinking rate of cells are the measurable factors governing loss of autotroph mass. Individual phytoplankton species separate better on the basis of different sinking rates. Diatoms and cryptomonads prefer high turbulence. Blue-green algae and dynoflagellates do not thrive in minimal turbulence, and green algae occupy middle range of conditions. In contrast to temperage lakes, phytoplankton succession in Lake Lanao consists of a series of numerous episodes initiated by abrupt changes in abiotic factors. However, events within any given episode bear resemblance to intra-episode events in temperate lakes. (Harris-Wisconsin)
W80-04363

LAKE MACROPHYTES AS THE FOOD OF ROACH (RUTILUS RUTILUS L.) AND RUDD (SCARDINIUS ERYTHROPHTHALMUS L.) I. SPECIES COMPOSITION AND DOMINANCE RELATIONS IN THE LAKE AND FOOD,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Prejs, and H. Jackowska.
Ekologia Polska, Vol 26, No 3, p 429-438, 1978. 7 Tab, 4 Ref.

Descriptors: *Submerged plants, *Masurian Lakes(Poland), *Fish diets, Rooted aquatic plants, Roach fish, Rudd fish, Lake Beldany(Poland), Lake Warniak(Poland), Lake Mikolajskie(Poland), Fish food organisms, Elodea canadensis, Characeae, Ceratophyllum demersum, Potamogeton pectinantus, Potamogeton lucens, Batrachium circinatum, Macrophytes, Size, Poland.

Submerged macrophyte food contributions to different sizes of two fish species were investigated in three eutrophic lakes in the Masuria district of northern Poland. Macrophytes in roach fish diets do not exceed 35% of total food weight in lakes Beldany and Mikolajskie but achieve 90% in roach from Lake Warniak. The percentage of macrophytes in rudd fish diets vary with fish size; it does not exceed 15% for individuals less than 7 cm body length, whereas it reaches 85-99% of total food weight for individuals longer than 16 cm. In the macrophytes eaten by the roach, Elodea canadensis dominates. Characeae and Certophyllum demersum are also important in Lake Mikolajskie roach, and C. demersum and Potamogeton pectinatus in Lake Warniak roach. E. Canadensis dominates in rudd diets from lakes Mikolajskie and Warniak, whereas C. demersum and E. canadensis dominate in the macrophyte eaten by Lake Beldany rudd. No essential differences occur in composition and dominance structure of macrophytes consumed by different size classes of fish. Similarly, the number of macrophyte species found in guts of different size fish do not vary. In each intenstine, macrophyte fragments represent an average of 2-3 species. Both fish species use most submerged macrophytes as food when the latter are found in sufficiently high densities. However, some relatively abundant macrophytes (P. lucens, Batrachium circinatum) are not eaten. (Harris-Wisconsin)
W80-04364

GROWTH RESPONSES OF SELECTED FRESHWATER ALGAE TO TRACE ELEMENTS AND SCRUBBER ASH SLURRY GENERATED BY COAL-FIRED POWER PLANTS,
Iowa State Univ., Ames. Dept. of Botany.
R. W. Vocke, K. L. Sears, J. J. O'Toole, and R. B. Wildman.
Water Research, Vol 14, p 141-150, 1980. 8 Tab, 67 Ref.

Descriptors: *Aquatic algae, *Growth rates, *Industrial wastes, *Inhibition, Bioassay, Trace elements, Powerplants, Coals, Fossil fuels, Arsenic compounds, Cadmium, Mercury, Scenedesmus, Toxicity, *Coal powerplants, *Ash, *Arsenic, *Selenium.

In laboratory studies, the freshwater algae Ankistrodesmus falcatus, Scenedesmus obliquus, Selenastrum capricornutum, and Microcoleus vaginatus were exposed to potential pollutants from coal-fired power plants, and their growth responses were evaluated. Using a modification of the EPA Algal Assay Procedure Bottle Test, algae were incubated in media containing As(V) as Na2HAs04.7H20, Cd(II) as CdS04, Hg(II) as HgS04, Se(VI) as Na2Se04, in solution, and scrubber ash slurry generated at a western U.S. coal-fired power plant complex. First significant inhibition levels as well as algistatic-algicidal levels are reported. The median effective concentration (EC50) values for the potential pollutants ranged from 0.048-30.761 mg/l (0.00064-0.41058M) As(V), 0.005-0.019 mg/l (0.00004-0.00017 M) Cd(II), 0.033-0.253 mg/l (0.00016-0.00126 M) Hg(II), 0.033-8.511 mg/l (0.00042-0.10779 M) Se(VI), and 3.048-15.417% scrubber ash slurry extract (SASE). (Deal-EIS)
W80-04386

RESPONSE OF THE TENCH (TINCA TINCA L.) TO POTASSIUM NITRATE ENRICHED WATER,
Lyon-1 Univ., Villeurbanne (France). Lab. de Physiologie Generale et Comparee.
For primary bibliographic entry see Field 5B.
W80-04387

THE FLAX POND ECOSYSTEM STUDY: EXCHANGES OF INORGANIC NITROGEN BETWEEN AN ESTUARINE MARSH AND LONG ISLAND SOUND,
Marine Biological Lab., Woods Hole, MA.
For primary bibliographic entry see Field 2L.
W80-04389

EFFECTS OF TRACE METALS ON GROWTH OF YELLOW PERCH (PERCA FLAVESCENS) AS MEASURED BY RNA-DNA RATIOS,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
P. K. Kearns, and G. J. Atchison.
Environmental Biology of Fish, Vol 4, No 4, p 383-387, 1979. 1 Fig, 1 Tab, 33 Ref.

Descriptors: *Toxicity, *Zinc, *Cadmium, *Yellow Perch, Growth rates, Fish physiology, Absorption, Seasonal, Growth stages, Heavy metals, Mode of action, Biochemistry, *DNA, *RNA.

Relationships between sublethal concentrations of cadmium and zinc in natural water and metal uptake by and growth of fish were investigated. RNA-DNA ratios and weight gain were used to assess seasonal growth differences between yellow perch populations from contaminated and control sites. Whole-body concentrations of cadmium and zinc in young-of-the-year perch were significantly different between sites. Measurable growth differences did occur and were significantly correlated with cadmium levels. Growth differences that were prominent during mid-summer were reduced by late summer. RNA-DNA ratios were sensitive indicators of fish growth. (Deal-EIS)
W80-04390

POPULATION STRUCTURE AND SPECIES COMPOSITION OF THE FREE-LIVING NEMATODES INHABITING SANDS OF THE NEW YORK BIGHT APEX,
City Coll., New York. Dept. of Biology.
J. H. Tietjen.
Estuarine and Coastal Marine Science, Vol 10, p 61-73, 1980. 3 Fig, 6 Tab, 23 Ref.

Descriptors: *Animal populations, *Nematodes, *Habitats, Spatial distribution, Bottom sediments, Heavy metals, Sands, Coarse sediments, Particle size, Chromium, Copper, Lead, Zinc, Municipal wastes, New York Bight, *Species diversity.

The free-living nematodes inhabiting silty and medium to coarse sands at nine stations in the New York Bight Apex were studied from August 1973 to September 1974. Average population densities ranged from 221 to 1381; no significant differences in density associated with sediment type, organic carbon or heavy metal concentrations were observed. In medium sands with low organic carbon and low heavy metal concentrations the nematode fauna was characterized by: (1) dominance by members of the families Chromadoridae and Desmodoridae; (2), low relative abundance of the family Comesomatidae; and (3), high species diversity. In silty sands, and also in medium sands with high organic carbon and/or high heavy metal concentrations, the fauna was marked by: (1) low relative abundances of the Chromadoridae and Desmodoridae; (2), high dominance of the Comesomatidae; and (3), low species diversity. In medium sands species diversity was significantly inversely correlated with increased concentrations of Cr, Cu, Pb and Zn. However, no such relationship existed in silty sands. Contaminated medium sands were also marked by high relative abundances of the comesomatid Sabatieria pulchra, which may be able to tolerate stressed sands much better than the normal inhabitants of such sediments; species belonging to the families Chromadoridae and Desmodoridae. (Deal-EIS)
W80-04391

SODIUM AND POTASSIUM IONS EFFECTS ON PHOSPHORUS TRANSPORT IN ALGAL CELLS,
EcoISciences Inc., South Bend, IN.
S. C. Mohleji, and F. H. Verhoff.
Journal of the Water Pollution Control Federation, Vol 52, No 1, p 110-125, 1980. 13 Fig, 1 Tab, 40 Ref.

Descriptors: *Aquatic algae, *Eutrophication, *Phosphorus, *Metabolism, Absorption, Sodium, Potassium, Ions, Membrane processes, Chemical reactions, Nutrients, Lakes, Cytological studies, Chlorophyta, Cyanophyta, *Selenastrum, *Microcystis.

Phosphorus is a substantive part of microbial biomass usually in stoichiometric limitation and thus is cited as the cause of eutrophication. However, microbial biomass is kinetic and not stoichiometric and thus any constituent that alters the rate of microbial nutrient uptake could alter the eutrophic state of a water body. This paper contains an investigation of the influence of sodium and potassium concentrations on phosphorus uptake in Selenastrum capricornutum and Microcystis aeruginosa. The phosphorus uptake rate by Selenastrum was found to be a function of time and of sodium and initial phosphorus concentrations. The P-uptake rate increased rapidly as Na+ increased from 0 to 4 mg/l, but slowly in the range 4 to 20 mg/l. K+ apparently decreased the P-uptake by Selenastrum. Compared to Selenastrum, Microcystis proved highly efficient in absorbing P and its absorption ability was not significantly affected by the presence of Na+ or K+. (Deal-EIS)
W80-04392

EFFECTS OF CHLOROBROMINATED AND CHLORINATED COOLING WATERS ON ESTUARINE ORGANISMS,
Academy of Natural Sciences of Philadelphia, Benedict, MD.
L. H. Liden, D. T. Burton, L. H. Bongers, and A. F. Holland.
Journal of the Water Pollution Control Federation, Vol 52, No 1, p 173-182, 1980. 5 Tab, 50 Ref.

Descriptors: *Cooling waters, *Chlorination, *Toxicity, *Estuarine environment, Halogens, Bromine, Food chains, Powerplants, Oysters, Clams, Mortality, Copepods, Bioassays, Respiration, Phytoplankton, Fish physiology, Atlantic Menhaden, *Spot, *Leiostomus.

Toxicities of chlorobrominated and chlorinated cooling waters to selected estuarine food-chain

organisms were investigated during an on-site power plant study. Survivals were similar among juvenile Atlantic menhaden (Brevoortia tyrannus) and spot (Leiostomus xanthurus) after exposures to BrCl- and Cl2-treated condenser effluents, Juvenile American oysters (Crassostrea virginica) and brackish water clams (Rangia cuneata) had no halogen-atributable mortalities after 15-day exposures. Similar survival reductions were recorded for copepods (Acartia tonsa) subjected to BrCl or Cl2 residuals (<0.100 mg/l) for 24 hours. Eductions in oxygen evolution (77 to 388%) and carbon-fixation (40 to 71%) rates and increased respiration rates (56 to 1,276%) of entrained phytoplankton were recorded from both chlorobrominated and chlorinated samples. BrCl and Cl2 residuals thus appear to have similar toxicities to estuarine organisms. (Deal-EIS)
W80-04393

DEVELOPMENT AND SURVIVAL OF EMBRYOS OF LAKE HERRING AT DIFFERENT CONSTANT OXYGEN CONCENTRATIONS AND TEMPERATURES,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
L. T. Brooke, and P. J. Colby.
The Progressive Fish-Culturist, Vol 42, No 1, p 3-9, 1980. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Herrings, *Water temperature, *Dissolved oxygen, *Toxicity, Water chemistry, Growth rates, Mortality, Habitats, Hatching, Fry, Embryonic growth stage, Fish physiology, Freshwater fish, Lake Herring, Coregonus.

Eggs of lake herring (Coregonus artedii) were incubated in a continuous-flow system at four constant water temperatures (2-8C) and five dissolved oxygen (DO) concentrations (1-12 mg/l). In comparison with incubation time at 12 mg/l DO, time to median hatch was significantly longer at 2 mg/l at 6C (no hatch at 1 mg/l), at 3 mg/l or less at 4C, and at 4 mg/l or less at 2C. The time between hatching of the first and last eggs varied inversely with temperature. Mean total lengths of newly hatched fry were significantly shortened at 1 and 2 mg/l DO. At 6 and 8C, percent survival through hatching was greater than at 2 and 4C at DO of 4 mg/l or more, but fell to zero at 1 mg/l. The percentage of normal fry produced decreased noticeably below 4 mg/l DO. The optimum temperature for highest percentage survival of normal fry decreased directly with the level of dissolved oxygen. The temperatures at which the highest percentages of normal fry hatched from eggs incubated at DO concentrations of 4 or 8, 2, and 1 mg/l, were 6, 4, and 2C, respectively-indicating a decreasing DO demand by embryos incubated at the lower temperatures. Our findings supported a previously published hypothesis that DO concentrations below 4 mg/l can be adverse to survival and development of coregonid embryos in nature. (Deal-EIS)
W80-04394

A COMPARISON OF THE ACUTE TOXICITIES OF TEN HEAVY METALS TO PHYTOPLANKTON FROM SAANICH INLET, B.C., CANADA,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
J. T. Hollibaugh, D. L. R. Seibert, and W. H. Thomas.
Estuarine and Coastal Marine Science, Vol 10, p 93-105, 1980. 5 Fig, 2 Tab, 49 Ref.

Descriptors: *Heavy metals, *Toxicity, *Phytoplankton, Copper, Mercury, Lead, Cadmium, Zinc, Nickel, Chromium, Bioassay, Inhibition, Growth rates, Aquatic algae, *Selenium, *Arsenic, *Antimony, *Thalassiosira.

The acute toxicities of Cu, Hg, Pb, Cd, Zn, Ni, Cr, Se, Sb, and As to Saanich Inlet phytoplankton were determined in enrichment culture bioassays. The toxicity of ions of a single metal to natural assemblages of phytoplankton enriched with nitrate, phosphate, and silicate was assessed by measuring the inhibition of plant growth. Toxicity to Thalassiosira aestevalis isolated from a June phytoplankton population was determined in a medium made of glass-fiber filtered Saanich Inlet seawater enriched with nitrate phosphate, and silicate. The concentration of a metal causing inhibition of growth under these conditions ranged from about 30 nannoM Hg to >1000 nannoM, Se, Sb, Cr, and Ni. The growth-inhibiting concentration of a given metal was similar to both natural populations and the Thalassiosira culture. Shifts in the species composition relative to controls were observed when natural assemblages were exposed to toxic levels of metals. (Deal-EIS)
W80-04398

DIEL PATTERNS OF PHYTOPLANKTON PRODUCTIVITY AND EXTRACELLULAR RELEASE IN ULTRA-OLIGOTROPHIC LAKE TAHOE,
California Univ., Davis. Div. of Environmental Studies.
M. M. Tilzer, and A. J. Horne.
Internationale Revue der gesamten Hydrobiologie, Vol 64, No 2, p 157-176, 1979. 8 Fig, 6 Tab, 55 Ref. NSF-RANN GI-22 and ERS 74-22675.

Descriptors: *Lake Tahoe(CA-NV), *Diel migration, *Phytoplankton, *Biorhythms, Oligotrophy, Diatoms, Chrysophyta, Primary productivity, Photosynthesis, Thermal stratification, Mixing, Cytological studies, Vertical migration, California, Nevada.

Lake Tahoe, California, phytoplankton is dominated by diatoms and chrysophytes. Mixing and thermal stratification are the main factors influencing seasonal productivity. Due to a relatively small (1.6 times the lake area) infertile watershed, the average annual primary production rates of the entire trophogenic zone are 0.5-0.6 g C/cu m. Between April and September 1975 a series of measurements was taken at the lake in order to assess the diel periodicity of phytoplankton photosynthesis and of environmental factors that relate to algae. Photosynthesis in shallow waters is light-inhibited throughout the day. Photosynthetic rates per unit chlorophyll-a, shows consistent relationship to subsurface light within single 24-hour periods, but varies between dates of experiments. Photosynthesis in mixed water columns is depressed in the afternoon due to a reduction in the photosynthetic potential of algae. Since extracellular release averages between 7.8 and 17.2% of total production rates and shows little vertical differentiation, damage of algal cells by light can be excluded. Overnight respiratory losses comprises at least 30% of the carbon assimilated during the preceding day. Integral photosynthesis shows a logarithmic correlation with incident light. This correlation can be used to predict daily production rates from mid-day incubation with an error of less than 10%. (Harris-Wisconsin)
W80-04399

THE PROCESS OF FISH FAUNA RESTORATION IN THE RIVER PEK FOLLOWING THE CATASTROPHIC OUTBREAK OF GANGUE FROM THE COPPER MINES 'MAJDANPEK' IN YUGOSLAVIA,
Institute for Biological Research, Belgrade (Yugoslavia).
D. Jankovic.
Symposia Biologica Hungarica, Vol 19, p 141-149, 1979. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Mine wastes, *Toxicity, *Biological communities, *Rivers, Copper, Heavy metals, Spoil banks, Chemical wastes, Waste dumps, Fish migrations, Aquatic populations, Fish populations, Bioindicators, Growth rates, *Yugoslavia, River Pek, Sediments.

As a consequence of repeated tectonic disturbances, a breach of the ore gangue of a copper mine occurred in Serbia in January 1974. The ore gangue was discharged together with water into the River Pek (Danube area) destroying its entire ichthyofauna. Studies conducted for four years showed the process of river restoration and the gradual recovery of fishes immigrating from the unpolluted upper river sections, its tributaries and the river danube. Living conditions have been studied following the catastrophe observing the growth of fishes as well as the pollution of the river by saprobity indicators. (Deal-EIS)
W80-04400

EFFECT OF CERTAIN ORGANOCHLOR INSECTICIDES ON PRIMARY PRODUCTION IN A FRESHWATER POND,
North-Eastern Hill Univ., Shillong (India). Dept. of Zoology.
S. A. K. Nasar.
Progress in Water Technology, Vol 11, No 6, p 247-251, 1979. 1 Tab, 23 Ref.

Descriptors: *Pesticide toxicity, *Primary productivity, *Phytoplankton, Chlorinated hydrocarbon pesticides, Aldrin, Dieldrin, Endrin, Inhibition, Photosynthesis, Mode of action, Insecticides.

Experiments were conducted to assess the effects and degree of toxicity of certain widely used organochlor insecticides i.e. Aldrin, Dieldrin and Endrin, on primary production of phytoplankton. The insecticides Aldrin, Dieldrin and Endrin showed a retardation of primary production in phytoplankton of 37.9%, 25.0% and 14.8% over control at 0.5 ppm, 0.01 ppm and 1.0 ppm respectively. The primary production was found to be nil at 1.0 ppm, 0.1 ppm and 1.5 ppm concentration of Aldrin, Dieldrin and Endrin respectively. The results of the present investigation thus sound a note of warning that the insecticides should be used carefully in the field, keeping in mind high toxicity, inhibiting phytosynthesis effect and harmful cumulative effect on the primary productivity of the adjacent water bodies. (Deal-EIS)
W80-04401

THE EFFECTS OF INTERACTING SALINITY, CADMIUM, AND MERCURY ON POPULATION GROWTH OF AN ARCHIANNELID, DINOPHILUS GYROCILIATUS,
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 5A.
W80-04403

BEHAVIOURAL STUDIES ON MUSSELS UNDER CHANGING ENVIRONMENTAL CONDITIONS,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 5A.
W80-04404

INFLUENCE OF THERMAL CHALLENGE ON CONDITIONED FEEDING FORAYS OF JUVENILE RAINBOW TROUT,
Environmental Research Lab.-Duluth, MN.
B. H. Munson, J. H. McCormick, and H. L. Collins.
Transactions of the American Fisheries Society, Vol 109, p 116-121, 1980. 3 Fig, 15 Ref.

Descriptors: *Fish behavior, *Toxicity, *Water temperature, *Rainbow trout, Juvenile growth stage, Heated water, Thermal stress, Heat resistance, Mortality, Laboratory tests, *Acclimation.

Juvenile rainbow trout (Salmo gairdneri) conditioned to traverse a 2.4 m-long channel to receive a food reward were subjected to in-transit thermal challenges. Conditioning was to a criterion that required 80% of the fish to leave the 'home' area and reach the 'reward' area within 2 minutes of release. Challenges were at successive 3C increments above acclimation or the previous challenge temperature. Fish were first observed to delay their entrance into the intervening heated water at challenge temperatures of 12-15C above acclimation. At each increment above 12-15C over acclimation temperature, delay in transit increased: however, complete group inhibition was never achieved. Above their critical thermal maximum (CTM) the reward was achieved even at the expense of deaths among the achievers. Responses were the same whether fish were challenged individually or as groups. Fish exposed to their CTM without prior challenges at less stressful temperatures responded similarly to those receiving progressively greater challenges. (Deal-EIS)

W80-04405

EFFECT OF SOME PESTICIDES ON THE RHYTHMIC ADDUCTOR MUSCLE ACTIVITY OF FRESH-WATER MUSSEL LARVAE,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 5A.
W80-04406

MASSIVE FISH MORTALITIES CAUSED BY ALGAL BLOOMS IN EUTROPHIC ECOSYSTEMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. Barica.
Symposia Biologica Hungarica, Vol 19, p 121-124, 1979. 1 Fig, 13 Ref.

Descriptors: *Eutrophication, *Fishkill, *Seasonal, Cyanophyta, Nutrients, Ammonia, Dissolved oxygen, Oxygen requirements, Growth rates, Rainbow trout, Trophic level, Canada, Blue green algae.

Development of noxious Cyanophyte blooms from high inputs of nutrients, their rapid die-off and lysis result in massive fish mortalities from oxygen depletion and high ammonia levels (summerkill). This phenomenon, representing the ultimate stage of the eutrophication process, causes seasonal large-scale catastrophes in the fisheries of many countries of the temperate and warm climatic zones. Findings of limnological research on Canadian prairie lakes over 1971-1977 are summarized with particular reference to the mechanism, ecological impact, prediction and prevention of the phenomnon. (Deal-EIS)
W80-04408

THE INFLUENCE OF SALINITY ON BEHAVIOUR AND OXYGEN UPTAKE OF THE HERMIT CRAB PAGURUS BERNHARDUS L.,
University Coll. of North Wales, Bangor. Marine Science Labs.
J. Davenport, P. M. C. F. Busschots, and D. F. Cawthorne.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 127-134, 1980. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Crabs, *Salinity, *Oxygen requirements, Animal physiology, Animal metabolism, Toxicity, Water chemistry, Animal behavior, Habitats, Adaptation, Dissolved oxygen, *Pagurus, *Hermit crab, *Acclimation.

A survey of tidal pools on the shore of the Menai Strait showed that hermit crabs are largely confined to water of 25 o/ooS or more. Experiments showed that specimens of Pagurus bernhardus retreated into their shells when environmental salinity levels fell to 20.5-22.5 o/ooS. This critical range was independent of rate of salinity change. However, acclimation to water of 23.1 o/ooS for more than 2 weeks lowered this behavioural threshold to 15.5 o/ooS. In respirometric experiments, hermit crabs were found to be 'oxygen conformers' since oxygen consumption fell with declining oxygen tension, especially below 30% air saturation. Crabs which had retreated into their shells in water of 16.5 o/oo or less showed negligible oxygen uptake whereas those which had retreated whilst in full seawater showed substantial oxygen consumption. These observations suggest that hermit crabs not only retreat into their shells at low salinity, but also cease ventilating their branchial chambers. Pagurus was found to survive in oxygen free sea water for 7 h, yet survived in fresh water for less than 3 h. This suggests that the withdrawn hermit crab succumbs to haemolymph dilution rather than to oxygen lack at low salinities. (Deal-EIS)
W80-04412

EFFECT OF ORGANOPHOSPHATE INSECTICIDE 'OWADOFOS PLYNNY-50' (FENITROTHION) ON BIOELECTRIC CHANGES IN CARDIAC MUSCLE OF EEL, ANGUILLA ANGUILLA L.,
Institute of Ichthyology, Szczecin (Poland). Dept. of Fish Physiology.
J. Muzykiewicz.
Acta Ichthyologica et Piscatoria, Vol 8, No 2, p 77-89, 1978. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Pesticide toxicity, *Eels, *Animal physiology, Organophosphorus pesticides, Mode of action, Inhibition, Animal metabolism, Membrane processes, Mortality, Bioassay, Lethal limit, *Fenitrothion, *Cardiovascular system, *Electrophysiology.

The effect of an organophosphate insecticide 'Owadofos plynny-50' (Fenitrothion) is shown in eel as a progressive bradycardia, elongation of ventricular changes (Q-T), and of an autonomic depolarisation of excitation-generating centres (T-P). Intravenal application of catecholamines delays and moderates the ECG changes brought about by the insecticide. (Deal-EIS)
W80-04416

MERCURY IN WATER, ORGANISMS AND SEDIMENTS FROM A SECTION OF THE TURKISH MEDITERRANEAN COAST,
Middle East Technical Univ., Ankara (Turkey). Dept. of Marine Sciences.
For primary bibliographic entry see Field 5B.
W80-04417

MORTALITY, GROWTH AND FECUNDITY OF TRANSPLANTED MUSSEL AND BARNACLE POPULATIONS NEAR A PULP MILL OUTFALL,
Fisheries and Marine Service, Vancouver (British Columbia).
R. S. S. Wu, and C. D. Levings.
Marine Pollution Bulletin, Vol 11, p 11-15, 1980. 6 Fig, 23 Ref.

Descriptors: *Mussels, *Toxicity, *Pulp wastes, Mortality, Growth rates, Fecundity, Industrial wastes, Animal growth, Reproduction, Chemical wastes, Canada, Pulp and paper industry, *Barnacles, *Balanus, *Mytilus.

The mortality, growth and fecundity of transplanted adult mussel (Mytilus edulis) and barnacle (Balanus glandula) populations near a kraft pulp mill outfall at Port Mellon, British Columbia, were determined. The results indicated that adults of both species were tolerant of bleached kraft pulp mill effluent and survived near the pulp mill outfall. However, the growth rates of both species were retarded when compared with those at the control station. The reproductive activities of the transplanted barnacles were also impaired. (Deal-EIS)
W80-04418

CHLORINATED HYDROCARBONS IN FISH-EATING BIRDS FROM THE GDANSK BAY, BALTIC SEA,
Morski Inst., Gdansk (Poland).
For primary bibliographic entry see Field 5B.
W80-04419

AN AQUATIC SAFETY ASSESSMENT ON LINEAR ALKYLBENZENE SULFONATE (LAS): CHRONIC EFFECTS ON FATHEAD MINNOWS,
Proctor and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5A.
W80-04420

DISTRIBUTION, ABUNDANCE, COMMUNITY STRUCTURE, AND TROPHIC RELATIONSHIPS OF THE BENTHIC INFAUNA OF THE NORTHEAST GULF OF ALASKA,
Alaska Univ., Fairbanks. Inst. of Marine Science.
H. M. Feder, and G. E. M. Matheke.
In: Environmental Assessment of the Alaskan Continental Shelf, Final Reports of Principal Investigators. Vol 6: Biological Studies, p 1-256, December 1979. 19 Fig, 33 Tab, 99 Ref, 5 Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil pollution, *Benthos, *Ecosystems, *Baseline studies, *Water pollution effects, Alaska, Resources development, Environmental effects, *Outer Continental Shelf, Northern Gulf of Alaska(NEGOA), Trophic interactions, Petroleum development.

The objectives of this study were: (1) a qualitative and quantitative inventory of benthic species within and adjacent to identified oil-lease sites in the northeast Gulf of Alaska (NEGOA), (2) a description of spatial and temporal distribution patterns of selected species in the designated study area, and (3) observations of biological interrelationships, specifically trophic interactions, between components of the benthic biota. Basic information on diversity of the fauna is available. Diversity appears to increase in areas where the sedimentation rate is reduced and the presence of sand and gravel substrates increase environmental heterogeneity. Numerical analysis of the benthic infauna delineated four major site groups. One of these site groups, the Inshore Group, consisted of sites with predominantly silt-clay sediments located on the continental shelf. Its fauna was dominated by deposit-feeding species which were also present at all other sites. An example is given on a diesel fuel spill resulting in oil becoming adsorbed on sediment particles with resultant mortality of many deposit feeders on sub-littoral muds. Bottom stability was altered with the death of these organisms, and a new complex of species became established in the altered substratum. It is suggested that oil-related mortality of deposit feeders could result in a changed near-bottom sedimentary regime with subsequent alteration of species composition. Development of monitoring programs based on species composition at selected sites is recommended. (Sinha-OEIS)
W80-04421

BASELINE STUDIES OF FISH AND SHELLFISH RESOURCES OF NORTON SOUND AND THE SOUTHEASTERN CHUKCHI SEA,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
R. J. Wolotira, Jr., T. M. Sample, and M. Morin, Jr.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 6: Biological Studies, p 258-572, December 1979. 139 Fig, 87 Tab, 36 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Fish, *Shellfish, *Baseline studies, *Resources development, *Environmental effects, Oil pollution, Water pollution effects, Alaska, Distribution, *Outer Continental Shelf, Norton Sound, Chukchi Sea, Ecological distribution, Petroleum development.

Findings from an intensive six-week survey (September-October, 1976) of fish and shellfish fauna in Norton Sound, the southeastern Chukchi Sea, and adjacent waters are presented and a brief review of other pertinent information on the survey region is discussed. Results of the survey defined the distribution and centers of abundance of several fish, crab, and snail species within the survey region and period. In addition, standing stock estimates and species composition of demersal fauna by geographic subdivisions of the survey region were determined. Analyses of species associations show recurrent groupings of certain species and their regional distributions. Estimates of biological characteristics, including size and age composition, length-weight relationships, and growth characteristics are provided for dominant fish species and for several species of crabs and snails. Most species studied are found in highest relative abundance in shallow, warm-water regions and greatest density occurs in Norton Sound. Growth of most fish appears greatest in areas studied south of Bering Strait. Almost no fish species were encountered in either sufficient size or quantity to be considered as potential for commercial harvest. (Sinha-OEIS)
W80-04422

TROPHIC RELATIONSHIPS AMONG ICE INHABITING PHOCID SEALS AND FUNCTIONALLY RELATED MARINE MAMMALS,
Alaska Dept. of Fish and Game, Fairbanks.
L. F. Lowry, K. J. Frost, and J. J. Burns.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 6: Biological Studies, p 573-629, December 1979. 14 Fig, 8 Tab, 72 Ref, Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Mammals, *Oil pollution, *Baseline studies, *Environmental effects, *Water pollution effects, Resources development, Ecosystems, Alaska, *Outer Continental Shelf, Beaufort Sea, Trophic relationships, Prey.

The trophic relationships of Beaufort Sea marine mammals, primarily ice-inhabiting seals, have been investigated since 1975. This report is an effort to synthesize the information collected since that time and make it available to resource managers for consideration during Environmental Impact Statement preparation and policy formulation. The main objective has been to develop an understanding of the trophic relationships of marine mammals and to assess the potential effects on marine mammals of changes in the trophic structure of the Beaufort Sea which may result from OCS exploration and development. Not only is it important to know the direct effects of hydrocarbons on critical prey species, but it is also necessary to evaluate temporal variations in prey sensitivity, critical times or areas for particular prey species and critical feeding periods for predator species. Pollutant levels high enough to cause large-scale die-offs of individuals will probably occur only on a very localized basis (except where oil or pollutants are trapped under the ice and transported long distances in a relatively unweathered state). The greatest concern may be with long-term sublethal low concentrations of pollutants which may affect locomotion, metabolism or reproduction and lead to substantial reduction of populations over several generations. These long-term reductions are of special concern in considering food availability to consumers. (Sinha-OEIS)
W80-04423

DEMERSAL FISH AND SHELLFISH ASSESSMENT IN SELECTED ESTUARY SYSTEMS OF KODIAK ISLAND,
Alaska Dept. of Fish and Game, Kodiak.
J. E. Blackburn.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 6: Biological Studies, p 727-852, December 1979. 7 Fig, 14 Tab, 21 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Fish, *Shellfish, *Fisheries, *Estuaries, *Oil pollution, Water pollution effects, Environmental effects, Baseline studies, Resources development, Alaska, *Outer Continental Shelf, Kodiak Island, Petroleum development, Demersal epifauna.

This study was designed to sample virtually all the habitats within Ugak, Kaiugnak and Alitak bays but principally it was addressed to the demersal epifauna that are vulnerable to capture by otter trawl, specifically, fish and crustacean shellfish. The demersal community is an important segment of the marine community in the Kodiak lease area. It is highly productive, supports a number of valuable fisheries and most of the species of this community have pelagic stages in their life history which would place them in a wide variety of habitats at different times during the year. The larval and early juvenile stages of many species are found in the near surface and nearshore zones where, it would seem, oil development impact would be most severe. Targeting studies upon these probably susceptible stages to the exclusion of other life history stages would be inappropriate. Similarly a premature decision as to which habitats (demersal or pelagic - nearshore) would be most susceptible to oil development impact would be inappropriate. The inescapable conclusion is that knowledge of the demersal community is very important to the process of locating sensitive areas and sensitive taxa. This study broadens the base of knowledge of the demersal community in the two bays, Ugak and Alitak. (Sinha-OEIS)
W80-04425

OIL SPILL VULNERABILITY, COASTAL MORPHOLOGY, AND SEDIMENTATION OF THE KODIAK ARCHIPELAGO,
South Carolina Univ., Columbia. Coastal Research Div.
M. O. Hayes, and C. H. Ruby.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 2: Physical Science Studies, p 1-155, December 1979. 32 Fig, 3 Tab, 54 Ref, 4 Append, NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil spills, *Baseline studies, *Water pollution effects, *Morphology, Alaska, Sediment transport, Coasts, Environmental effects, Resources development, Cold regions, *Outer Continental Shelf, Kodiak Island, Oil Spill Vulnerability Index.

The Oil Spill Vulnerability Index, as it applies to the Kodiak Archipelago is presented. It is based partly on the longevity of potential oil spills within each of the subenvironments. Forty-seven base maps are listed and under each base map, the 10 subclasses of the Oil Spill Vulnerability Index are listed with the number of shoreline kilometers falling into each class for that base map. Using the vulnerability classification, it is possible to make a few generalizations regarding the Kodiak area and its reaction to potential oil spills. In general, the area is quite high risk. Unfortunately, the Kodiak system is very complex and the higher risk areas do not lend themselves well to being protected during a spill. In many instances, a low risk rock scarp will lie just seaward of a large embayment with high risk pure gravel beaches. The indented (fjord) character of the islands will act as 'oil traps' for floating oil. Oil will tend to be moved deeper into the fjords rather than to be flushed out. In general this will result in an oiling of increasingly sensitive environments, since higher risk, lower energy classes are located deeper in fjords and embayments. Additionally, there are long periods of relatively low wind and wave energy, especially during the summer. A spill during one of these periods could prove particularly devastating. (Sinha-OEIS)
W80-04426

DYNAMICS OF NEAR SHORE ICE,
Washington Univ., Seattle. Polar Science Center.
R. Colony.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 2: Physical Science Studies, p 156-180, December 1979. 5 Fig, Append, NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil spills, *Ice, *Baseline studies, *Water pollution effects, Alaska, Environmental effects, Resources development, Cold regions, *Outer Continental Shelf, *Pack ice, Beaufort Sea, Chukchi Sea, Petroleum development, Nearshore.

The near shore pack ice of the Beaufort Sea and Chukchi Sea have a profound influence on the development of the gas and oil fields of Northern Alaska. Design of structures, security of sub-surface pipelines, and surface transport of oil is dependent on a knowledge of many of the properties of the near shore pack ice. Observations of ice motions are relevant for three borad reasons: the ice cover serves as a carrier of any petroleum products spilled in the Beaufort or Chukchi Sea so that the ice trajectories serve as a first estimate of the paths to be taken by the oil; the observations identify the important physical processes at work within the ice pack; and the ice motion is an observable quantity that is compared with a simulation of pack ice dynamics. The current study shows the near shore ice pack between Pt. Barrow and Cape Lisburne to move into the central Chukchi Sea during early summer and then to move north and west; probably to be incorporated into the transpolar drift stream. Once the ice moved toward the central Chukchi the mean motion was very similar to the drift of the summer of 1977. (Sinha-OEIS)
W80-04427

SEDIMENTOLOGY AND GEOCHEMISTRY OF SURFACE SEDIMENTS AND THE DISTRIBUTION OF FAULTS AND POTENTIALLY UNSTABLE SEDIMENTS, ST. GEORGE BASIN REGION OF THE OUTER CONTINENTAL SHELF, SOUTHERN BERING SEA,
Geological Survey, Menlo Park, CA.
J. V. Gardner, T. L. Vallier, W. E. Dean, K. Kvenvolden, and G. D. Redden.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 2: Physical Science Studies, p 181-271, December 1979. 35 Fig, 14 Tab, 66 Ref, Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Seismology, *Geology, *Hazards, Alaska, Sediments, Geochemistry, Resources development, Baseline studies, *Outer Continental Shelf, Bering Sea, St. George Basin.

The data and interpretations from studies of surface sediments, faults, and areas of potentially unstable sediment masses in the St. George Basin region of the outer continental shelf, southern Bering Sea are summarized. The report is divided into four major parts: Part 1 is an introduction which reviews methods used and the quantity of data collected during the contract period; Part 2 deals with the sedimentology and geochemistry of surface sediments; Part 3 discusses distributions of faults and areas of potentially unstable sediment; and Part 4 is a review of the major conclusions. Major faults are principally distributed along or near the borders of St. George basin and they trend parallel to the basin's long axis. Minor faults are widely distributed throughout the middle of St. George basin. Major faults are probably related to stress fields established by Mesozoic and Cenozoic plate motions and minor faults are related to high seismicity in the nearby Aleutian subduction zone. (Sinha-OEIS)
W80-04428

COASTAL PROCESSES AND MORPHOLOGY OF THE BERING SEA COAST OF ALASKA,
Geological Survey, Menlo Park, CA.
A. H. Sallenger, Jr., and J. R. Dingler.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 2: Physical Science Studies, p 377-441, December 1979. 29 Fig, 3 Tab, 16 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Morphology, *Geology, *Storms, *Hazards, *Baseline studies, Alaska, Resources development, Coasts, Paths of pollutants, Water pollution, Environmental effects, *Outer Continental Shelf, Bering Sea, Petroleum development, Coastal development set-back line.

The regional characterization of the physical environment of the Bering Sea coast of Alaska included determination of net longshore transport directions, characterization of coastal morphology, and reconnaissance of beach morphology and sediment characteristics. These types of studies were extended to Pavlov Bay and Cold Bay on the Pacific coast of the Alaska Peninsula. These potential deep water ports may serve offshore petroleum exploitation of the Bristol Bay area in the future. Results of these studies are used to obtain qualitative assessment of coastal stability, in preparing preliminary siting studies for coastal developments, and in the determination of the long-term directions of transport of particulate pollutants in the littoral system. Shallow offshore depths that characterize much of

the eastern Bering Sea shelf make coastal areas susceptible to storm surges of large magnitude. Potential consequences of storms in this environment pose hazards to coastal developments in addition to hazards resulting from flooding and wave activity alone. One use for this kind of data is to establish a coastal development set-back line. Developments within areas subject to inundation by storm surge or undermining by coastal erosion would be prohibited. Additional input into this analysis must include the long-term rate of erosion. For structures that must cross the coastline (e.g. pipelines) the maximum scour depth must be established for both storms and over the long-term. (Sinha-OEIS)
W80-04430

OIL SPILL TRAJECTORY ANALYSIS LOWER COOK INLET, ALASKA,
Dames and Moore, Los Angeles, CA.
R. Schlueter.
In: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol 2: Physical Science Studies, p 442-745, December 1979. 19 Fig, 8 Tab, 22 Ref, 4 Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil spills, *Model studies, *Baseline studies, *Water pollution effects, Alaska, Currents(Water), Wind velocity, Resourced development, Environmental effects, *Outer Continental Shelf, *Trajectories, Petroleum development, Cook inlet.

In continuing studies of the behavior of spilled oil in Lower Cook Inlet, behavior of a surface oil slick was represented by the trajectory of the centroid of the slick neglecting mass-dependent phenomena such as spreading, evaporation, sinking, etc. The velocity of the centroid was modeled as the linear, vectorial addition of wind velocity coupled to centroidal velocity by a coefficient of 3% and the total surface current velocity. A Dames & Moore oil spill numerical model embodying these concepts was used to carry out the analyses. The results of this project include not only the predicted oil spill behavior, but also the input wind and current fields. The fields developed represent the most recent synthesis of current measurement and modeling results available in October 1978. An overview of the oil spill model is given which provides the general framework of the analytic approach used to determine shoreline exposure due to postulated oil spills at selected sites. Details of the model, details of the environmental input data and a discussion of the methodology and results of the trajectory simulations are also presented. (Sinha-OEIS)
W80-04431

THE EFFECTS OF LOW LEVELS OF OIL ON AQUATIC BIRDS. A NON-TECHNICAL SUMMARY OF RESEARCH ACTIVITIES FY76 THROUGH FY78,
College of the Atlantic, Bar Harbor, ME.
J. O. Biderman, and W. H. Drury.
US Fish and Wildlife Service Biological Services Program Report No FWS/OBS-80-16, March 1980. 5 p, 1 Ref, Conducted in Cooperation with US Environmental Protection Agency.

Descriptors: *Birds, *Water pollution effects, *Oil pollution, Reproduction, Resources development, Environmental effects, *Outer Continental Shelf, Aquatic birds.

The reproductive period, including the time of growth and development of the young, is a highly sensitive time for any animal when physiological systems are acting at critical rates. Any slight interference, such as the addition of a stressful or toxic agent is likely to be disastrous. It has been demonstrated that exposure of adult waterbirds or their developing young to slight amounts of petroleum can seriously interfere with the reproductive process. Effects can range from interference with the physiology of reproduction to killing of embryos, production of developmental defects, stunting of growth and impairment of survival ability when birds are stressed. Oil can be taken up by adults in their food or picked up on their feathers, and can be transferred to eggs or nestlings. Managers should be conscious of these effects, which though less apparent in nature, may in fact be more serious than the infrequent kill-offs occurring after catastrophic spills. For it may well turn out that a chronic reduction in reproductive success may be the most significant effect of oil pollution on populations of aquatic birds. (Sinha-OEIS)
W80-04432

ENVIRONMENTAL ASSESSMENT OF AN ACTIVE OIL FIELD IN THE NORTHWESTERN GULF OF MEXICO 1977-1978. VOLUME I - SYNOPSIS.
National Marine Fisheries Service, Galveston, TX. Southeast Fisheries Center.
Annual Report to the Environmental Protection Agency on work conducted under provisions of the Interagency Agreement during 1977-1978, June 1979. 78 p, 3 Fig, 1 Tab. EPA-IAG-05-E693-EO.

Descriptors: *Oil pollution, *Oil fields, *Water pollution effects, *Environmental effects, Gulf of Mexico, Resources development, Ecosystems, Projects, *Outer Continental Shelf, Environmental assessment, Buccaneer Oil Field.

Volume I - Synopsis is the first of three volumes in an annual report. It is designed to be used as a briefing document and as a key to more detailed scientific and technical information contained in the other volumes. The area selected for study is the operational Buccaneer Oil Field located approximately 49.6 km from Galveston Sea Buoy off Galveston, Texas. Objectives of the project are: (1) to identify and document the types and extent of biological, chemical and physical alterations of the marine ecosystem associated with Buccaneer Oil Field, (2) to determine specific pollutants, their quantity and effects, and (3) to develop the capability to describe and predict fate and effects of Buccaneer Oil Field contaminants. The Buccaneer Field has been in production for about 15 years thus allowing for the full development of oil-field-associated marine communities. There have been no major oil spills from this field although there have undoubtedly been losses of small amounts of oil. This project provides a unique opportunity for continued study of effects of chronic, low-level contamination of the marine ecosystem associated with oil and gas production in an established field. (Sinha-OEIS)
W80-04433

SLUDGE DUMPING: MEETING THE 1981 DEADLINE,
Environmental Protection Agency, New York.
R. T. Dewling, and P. W. Anderson.
In: Marine Technology/79 'Ocean Energy', Proceedings of 15th Annual Conference sponsored by the Marine Technology Society, held New Orleans, Louisiana, October 10-12, 1979. p 34-39, 1979. 3 Fig, 1 Tab. MTS, Washington, D.C.

Descriptors: *Waste disposal, *Sewage sludge, Environmental effects, Water pollution effects, *Outer Continental Shelf, *Ocean dumping, New York Bight.

The Marine Protection, Research and Santuaries Act of 1972 mandates that EPA 'prevent or strictly regulate' the dumping of waste materials into the ocean. The Act was amended in November 1977 to prohibit the dumping of harmful sewage sludge in the ocean after December 31, 1981. Scientific investigations, mainly by NOAA, have documented several adverse environmental impacts at the sludge and dredged material sites. These impacts include elevated concentration of heavy metals, organic matter, and bacterial in the water and bottom sediments with attendant threat of bioaccumulation in the food chain; reduced catches of bony fish in high-carbon sediment areas; FDA closure of extensive areas to shellfishing; enrichment resulting in increased phytoplankton productivity, the occurence of finrot, exoskeleton erosion, and gill clogging in certain marine life; and sediments in the vicinity of the dump sites devoid of normal benthic biological communities. The Congressional mandate has spurred sewage sludge generators to develop and implement alternate disposal methods. All options available have associated environmental risks since metropolitan area sludges contain pathogens, toxic metals, and persistent synthetic organic materials. No matter what method is chosen--landfill, incineration, pyrolysis, composting or recycling, some environmental impact will result. (Sinha-OEIS)
W80-04436

SEAFLOOR SAND MINING IN JAPAN,
National Research Inst. for Pollution and Resources, Tokyo (Japan).
T. Usami, K. Tsurusaki, T. Hirota, and J. W. Padan.
In: Marine Technology/79, 'Ocean Energy', Proceedings of 15th Annual Conference sponsored by the Marine Technology Society, held New Orleans, Louisiana, October 10-12, 1979. p 176-189, 1979. 14 Fig, 3 Tab, 5 Ref. MTS, Washington, D.C.

Descriptors: *Mining, *Resources development, Environmental effects, Erosion, *Outer Continental Shelf, *Offshore mining, Japan.

Rapid depletion of onshore deposits of construction aggregate has caused Japan to tap sand deposits in coastal waters. In recent years offshore mining has contributed 15 to 20% of total production of natural aggregate and about 10% of all aggregate used in Japan. Annual production is 60 to 70 million tons and is expected to increase. This paper describes the role of seafloor sand mining in Japanese industry as well as problems facing the expansion of the industry. Three problems which must be overcome are: the deeper water deposits located by the Geological Survey of Japan must be evaluated; technology to mine as deep as 300 meters, economically, must be developed; and finally, the environmental effects must be held to a minimum. Research will continue to focus on coastal erosion and turbidity effects as the main concerns. (Sinha-OEIS)
W80-04437

ENVIRONMENTAL CONCERNS FOR OTEC IDENTIFIED IN THE DOE OTEC ENVIRONMENTAL READINESS DOCUMENT,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. F. Haven.
In: Marine Technology/79, 'Ocean Energy', Proceedings of 15th Annual Conference sponsored by the Marine Technology Society, held New Orleans, Louisiana, October 10-12, 1979. p 326-330, 1979. 1 Tab. MTS, Washington, D.C.

Descriptors: *Environmental effects, *Hazards, *Energy conversion, *Resources development, Thermal pollution, Water pollution effects, Entrainment, Ecology, *Outer Continental Shelf, Ocean Thermal Energy Conversion(OTEC).

The findings and significance of the Department of Energy Environmental Readiness Document (ERD) for OTEC is presented. An ERD is prepared periodically for emerging energy technologies by the DOE Assistant Secretary for Environment and represents an analytical statement of DOE's environmental concerns with the technology. The ERD discusses the current status of knowledge for each concern, the time frame for potential realization of the concern, and the approximate magnitude of the environmental insult which could be realized. Nine environmental concerns are identified for OTEC in the ERD. Six of the nine concerns represent known environmental hazards, yet additional environmental research will be required for each in order to determine both their magnitude and their significance in the open ocean marine environment. (Sinha-OEIS)
W80-04438

1979 STATUS OF THE OTEC ENVIRONMENT PROGRAM,
California Univ., Berkeley. Lawrence Berkeley Lab.
P. Wilde.

In: Marine Technology/79, 'Ocean Energy', Proceedings of 15th Annual Conference sponsored by the Marine Technology Society, held New Orleans, Louisiana, October 10-12, 1979. p 340-345, 1979. 1 Fig, 3 Tab, 9 Ref. MTS, Washington, D.C.

Descriptors: *Water pollution effects, *Energy conversion, *Baseline studies, *Resources development, Thermal pollution, Chemical potential, Gulf of Mexico, Hawaii, Puerto Rico, *Outer Continental Shelf, Ocean Thermal Energy Conversion(OTEC), Ocean properties.

Preliminary surveys and laboratory studies are being conducted in the waters of Puerto Rico, The Gulf of Mexico, and Hawaii for moored or seacoast OTEC plants and in the equatorial South Atlantic for plant-ship operations to provide baseline data. These data plus existing archival information can be used to model effects of OTEC operations. Four major areas of concerns (1) redistribution of oceanic properties, (2) chemical pollution, (3) structural effects, and (4) socio-legal-economic; and 11 key issues associated with OTEC operation have been identified. Mitigating strategies can be used to alleviate many deleterious environmental effects of operational problems as biostimulation, outgassing, etc. Various assessment research studies on toxicity, biocide releases, etc., are under way to investigate areas where no clear mitigating strategy is available. Data from these programs is being integrated into a series of environmental compliance documents including a programmatic environmental impact assessment. (Sinha-OEIS)
W80-04439

COASTAL FRONTAL SYSTEMS AS A POLLUTANT CONTROL MECHANISM FOR OFFSHORE ENERGY PRODUCTION,

Science Applications, Inc., Bryan, TX. Ocean Science Div.
J. K. Lewisk.
In: Marine Technology 79, 'Ocean Energy', Proceedings of 15th Annual Conference sponsored by the Marine Technology Society, held New Orleans, Louisiana, October 10-12, 1979. p 389-396, 1979. 3 Fig, 3 Tab, 9 Ref. MTS, Washington, D.C.

Descriptors: *Environmental effects, *Oil pollution, *Oil spills, *Resources development, Water pollution control, Texas, Dispersion, Wind, *Outer Continental Shelf, Oil and gas production, Coastal frontal system.

A surface core of fresher water from the Mississippi Delta region is advected along the Texas coast due to longshore wind stress and can form a strong frontal zone 10-30 km offshore of an area where much oil and gas production occurs. Coastal fronts are environmentally important since the surface convergences that occur at the boundary of the dissimilar water types are capable of affecting the dispersal of spilled pollutants. This front can be considered as a buffer between offshore pollutant spills and the tourist-attractive coasts of Texas. The front can dominate the nearshore environment for much of the year, and historical wind stress data indicate that it could be expected along the upper Texas coast from September through April. The mechanism which support the frontal zone is discussed, and the results indicate that other as of yet undetected fronts may exist in areas close to river outflows. The flow regimes of the front are presented, the knowledge of which would allow private and government agencies to better plan contigencies for handling spills from offshore energy production or transport. (Sinha-OEIS)
W80-04440

AN EMPIRICAL STUDY OF FACTORS AFFECTING BLUE-GREEN VERSUS NONBLUE-GREEN ALGAL DOMINANCE IN LAKES,

Michigan State Univ., East Lansing. Dept. of Resource Development.
K. H. Reckhow, and J. T. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-169311, Price codes: A06 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, Project Completion Report, March 1980. 99 p, 17 Fig, 10 Tab, 65 Ref. OWRT A-102-MICH (3), 14-34-0001-9024.

Descriptors: *Algae, *Cyanophyta, *Lakes, *Blue-green algae, *Nonblue-green algae, *Algal dominance, Hydraulic detention, Variable relationships, Inorganic nitrogen, Hydraulic detention, Nitrogen, Alkaline water, *Temperate lakes, *Variable box plots, *Bivariate-discriminant plots.

In many lakes, the use and enjoyment of the water is limited due to the dominance of undersirable blue-green algae. Exploratory data analysis techniques were applied to 90 north temperate lakes included in the EPA National Eutrophication Survey to examine empirical relationships between: (1) the chemical and physical variables that affect algal dominance in lakes; and (2) the dominant algal type. Single variable box plots and bivariate-discriminant plots document the importance of the inorganic nitrogen concentration and hydraulic detention time in determining blue-green versus nonblue-green algal dominance in eutrophic lakes. The multivariate statistical technique of discriminant analysis was applied to 68 high alkalinity lakes in the data set to: (1) further identify variable relationships; and (2) construct a simple predictive model for algal dominance. Application of results are discussed in an ecological and management context.
W80-04441

STUDIES ON THE USEFULNESS OF DIFFERENT MESH-SIZE PLANKTON NETS FOR THICKENING ZOOPLANKTON,

Polish Academy of Sciences, Warsaw. Dept. of Hydrobiology.
J. Ejsmont-Karabin.
Ekologia Polska, Vol 26, No 3, p 479-490, 1978. 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Zooplankton, *Bottom sampling, *Plankton nets, *Eutrophication, *Lakes, Lake Mikolajskie(Poland), Lake Inulec(Poland), On-site data collections, Equipment, Rotifers, Crustaceans, Cyclopidae, Keratella cochlearis, Polyarthra vulgaris, Data collections, Monitoring, Size, Density, Trophic level, Poland.

Eight series of experiments were carried out July 1975 on two eutrophic lakes in Poland to determine how mesh size of a plankton net affects zooplankton composition of filtered samples; recommendations include using nets with smaller mesh sizes (20 micro mm) when filtering plankton in less fertile lakes and using larger mesh sizes (60 micro mm) when filtering plankton in eutrophic lakes. In Mikolajskie Lake (498 ha, 25.9 m max depth, 11.1m avg depth) and Lake Inulec (178.3 ha, 10.1 max depth, 4.6 m avg depth) four tests each were carried out; the tests utilized four different kinds of plankton nets: 10, 20, 30 and 60 micro mm mesh size. Results show that filtering lake water samples through these four net sizes causes losses of the original rotifer numbers; losses are 27%, 32%, 43% and 54%, respectively. Netting does not affect the number of crustaceans, mainly nauplii of Cyclopidae; only 10% of nauplii are lost when 60 micro mm mesh size netting are used. Types and magnitudes of losses among rotifer fauna depends not only on mesh size but also on morphology and body size of individuals and on density of animals within the filtered samples. Generally losses increase with greater individual body size and decrease with greater animal density. It is noted that the average number of eggs per female changes due to filtration; results include a slight reduction for the ovigerous species (Keratella cochlearis) and an almost two-fold increase for non-ovigerous species (Polyarthra vulgaris). (Harris-Wisconsin)
W80-04445

THE USE OF PERIPHYTON FROM LAKE ZURICH TO EXTIMATE THE ALGAL GROWTH POTENTIAL IN RIVER LIMMAT WATER,

Zurich Univ. (Switzerland). Hydrobiology-Limnology Station.
F. Schanz, and B. Betschart.
Swiss Journal of Hydrology, Vol 41, No 1, p 141-149, October 1979. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Algal growth potential, *Periphyton, *Bioassay, *River Limmat(Switzerland), *Sewage effluents, Lake Zurich(Switzerland), Effluents, Algae, Sewage disposal, Biomass, Methodology, Testing procedures, Chlorophyll, Proteins, Growth rates, Analytical techniques, Water water(Pollution), Variability, Laboratory tests, Environmental effects, Water quality, Switzerland.

This paper discusses sewage wastewater influence on algal growth potential in River Limmat water, downstream from Lake Zurich, Switzerland and methods used to estimate algal growth potential (AGP). When natural periphyton under nonsterile conditions is used to estimate AGP in River Limmat water, influence from the Zurich sewage treatment plant can be followed easily. Biomass is estimated by protein determination, chlorophyll determination, KMn04-consumation and ash-free dry weight, using natural periphyton in the bioassay. KMn04-consumption shows lesser standard deviation than is obtained with other determinations. Validity of biomass determination with KMn04-consumption or ash-free dry weight are practically the same. Variation coefficients are generally low. In routine experiments with large numbers of culture vessels, ash-free dryweight determinations are very time consuming. Therefore, KMn04-consumption method is preferred. AGP of the water from Quaibridge (Lake Zurich) to Unterengstringen-right is much lower than the AGP from Unterengstringen-left and sampling stations below. This is due to the influence of the sewage treatment plant Werdholzli immediately upstream of Unterengstringen on the left side of Limmat River. Differences between Unterengstringen-right and Unterengstringen-left are caused by incomplete mixing of river water with wastewater. (Danovich-Wisconsin)
W80-04446

EFFECT OF NUTRIENT INFLOW ON THE BACTERIAL FLORA IN THE RIVER SAKURAGAWA, JAPAN,

Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Seki, and Y. Takahara.
Internationale Revue Der Gesamten Hydrobiologie, Vol 64, No 3, p 417-424, 1979. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Eutrophication, *River Sakuragawa(Japan), *Nutrients, *Bacteria, Nitrogen, Phosphorus, Cyanophyta, Trophic level, Inorganic compounds, Domestic wastes, Fertilizers, Water pollution sources, Agricultural runoff, Plankton, Biomass, Density, Heterotrophy, Dystrophy, Nannoplankton, Microorganisms, Japan.

Organic nutrients for bacteria in the Sakuragawa River, Japan during June 1976-July 1977 were mainly autochthonous, suggesting that pollution was never present in sufficient quantity to induce dystrophy. The Sakuragawa drains 349 sq km, 26% of which is paddy fields fertilized by 1900 tons of nitrogen and 1600 tons of phosphorus annually. The city of Tsuchiura also discharges domestic wastes into the river; however, the river discharges only 520 tons of nitrogen and ten tons of phosphorus annually. Nutrient levels and bacteria were collected weekly from sampling stations located in: (1) headwaters free of pollution; (2) just upstream of Tsuchiura where nutrients are increased by agricultural runoff; (3) at the river mouth; and (4) at the estuary harbor. In polluted river areas, the percentage of heterotrophs in bacterioneuston (5.6%) is significantly different from that in bacterioplankton (7.7%). Statistical analysis reveal no significant difference in either percentage at any station in the polluted area. At upstream Station 1, bacterioplankton mean density is 1.6 million cells/ml. In the polluted area, bacterioplankton densities are 8.0 million cells/ml at Station 2; 7.6 million cells/ml at Station 3; and 11.0 million cells/ml at Station 4. Bacterioneuston density varies 8.7 million cells/ml at Station 2; 8.4 million cells/ml at Station 3 and 13.0 million cells/ml at Station 4. Mean density of planktonic heterotrophs at Station 1 ranges 1/50 to 1/100 of the values for polluted areas. (Danovich-Wisconsin)

W80-04447

THE ROLE OF ZOOPLANKTON IN THE NITROGEN DYNAMICS OF A SHALLOW ESTUARY,
Duke Univ., Beaufort, NC. Marine Lab.
S. L. Smith.
Estuarine and Coastal Marine Science, Vol 7, No 6, p 555-565, December 1978. 4 Fig, 2 Tab, 29 Ref. NSF GX33502.

Descriptors: *Zooplankton, *Estuaries, *Cycling nutrients, *Ammonia, *Ureas, *Newport River estuary(NC), Beaufort(NC), Nitrogen, Phytoplankton, Copepods, Primary productivity, Nitrogen cycle, Standing stocks, Shallow water, Nutrients, Nutrient requirements, Foods, Metabolism, Water properties, Water quality, Food chains, Estuarine environment, North Carolina.

Experiments in which nitrogen assimilation by phytoplankton and nitrogen release by copepods was observed in Newport River estuary, North Carolina, September 1973-April 1974, showed that zooplankton are probably not the major source of regenerated nitrogen. Both urea and ammonia are used by phytoplankton in the Beaufort estuary and are released by zooplankton at rates that depend on species, sex, season and feeding history. Phytoplankton primary productivity depends almost totally on regenerated nitrogen; amounts released by zooplankton provided an average of only 16% total phytoplankton nitrogen uptake. Other sources of regenerated nitrogen in the estuary are fish populations, benthic community, fouling community, sewage, microzooplankton and bacteria. Ammonia released by zooplankton averages 8% of the rate of ammonia assimilation by phytoplankton. Percentages range from 1% in October when phytoplankton standing crops are relatively large and phytoplankton ammonia assimilation high to 17% in March when phytoplankton standing stock is small and ammonia assimilation low. Release rates range 0.1-9.7 mg N/cu m d, while assimilation rates range 1-101 mg N/cu m d. Newport River estuary is part of a series of shallow estuaries behind the Outer Bands of North Carolina; average depth is 1.2 m. The estuary receives runoff from fertilized farmland, effluents from fish processing plants, and sewage from primary and secondary treatment plants. Copepod Acartia tonsa is numerically dominant at all times. (Danovich-Wisconsin)
W80-04448

ALGAL RESPONSE TO A THERMAL EFFLUENT: STUDY OF A POWER STATION ON THE PROVO RIVER, UTAH, USA,
Bringham Young Univ., Provo, UT. Dept. of Botany and Range Science.
L. E. Squires, S. R. Rushforth, and J. D. Brotherson.
Hydrobiologia, Vol 63, No 1, p 17-32, March 1979. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Provo River(UT), *Thermal pollution, *Electric powerplants, *Sessile algae, *Environmental effects, Algae, Diatoms, Thermal stress, Thermal water, Water temperature, Effluents, Primary productivity, Distribution, Speciation, Growth rates, Environmental gradient, Statistics, Statistical methods, Periphyton.

Water temperature increases caused by thermal discharges are highest 100-135 m downstream of the Hale generating station on the Provo River in Utah and a unique algal community is attributed to this thermal discharge. The attached algal community of this small fast-moving mountain river was observed October 1975-August 1977. Diatoms, Cladophora glomerata, and Hydrurus foetidus are major constitutents. Cocconeis placentula (euglypta) is common throughout the year and dominates diatom flora spring to fall. C. glomerata and H. foetidus are abundant fall to spring. Flora display an overall similarity in specific composition but with zonation related to local environmental conditions. Effects from elevated temperatures in river sections below the effluent area could not be distinctly isolated; however, the effluent area which estends 100-135 m downstream from the thermal discharge point contains flora significantly different from other river areas. The effluent area is characterized by heavy C. glomerata growth, lack of foetidus growth, high diatom production but low diversity, C. placentula dominance throughout the year and a consistently distinct diatom community composition. Temperatures in this area range 0-10C above ambient just below the outfall and 0-3.5C above ambient 135 m downstream. (Danovich-Wisconsin)
W80-04449

SPATIAL PATTERNS IN NORTH SEA PLANKTON,
Woods Hole Oceanographic Institution, MA.
J. H. Steele, and E. W. Henderson.
Deep-Sea Research, Part A-Oceanographic Research Papers, Vol 26, No 8, p 955-963, August 1979. 6 Fig, 16 Ref.

Descriptors: *Population dynamics, *Spatial distribution, *North Sea, *Plankton, Ecosystems, Distribution, Zooplankton, Grazing, Growth rates, Population, Temperature, Chlorophyll, Temporal distribution, Physical properties, Variability, Theoretical analysis, Nutrients, Phytoplankton.

Surveys of near-surface horizontal distributions of temperature, salinity, nitrate and chlorophyll were carried out April-June 1976 in the North Sea; results make it possible to distinguish periods when phytoplankton growth is affected mainly by physical dispersion from periods when grazing is the controlling factor. Data on chlorophyll and zooplankton concentrations confirm great variability in space and time, especially in scales 0.1-100 km and 1-100 days and this makes it difficult to interpret temporal sequences of data in terms of separate or combined effects of physical processes, nutrient limitation or grazing. The 1976 growth sequence, although irregular, was much lower than in earlier 1974 studies; this could have resulted from nutrient limitation. The spectral ratio of chlorophyll to temperature decreases or increases with increasing wave number for positive or negative growth rates. The variance slope ratio of chlorophyll and temperature is used to measure chlorophyll spectra divergence from that expected solely from physical processes. During periods of phytoplankton growth or significant plant-herbivore interactions, the slope is negative indicating increased biological variance at low wave numbers. Positive slope corresponds to a dominance of the limiting effects of nutrient and physical factors on phytoplankton with declining populations. A zero slope indicates that physical factors alone are dominant in determining phytoplankton distributions. Data indicate that grazing is the controlling factor in May 1976 because the variance slope is negative. (Danovich-Wisconsin)
W80-04450

FECUNDITY AND BODY SIZE OF PLANKTIC ROTIFERS IN 30 POLISH LAKES OF VARIOUS TROPHIC STATE,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
W. Sterzynski.
Ekologia Polska, Vol 27, No 2, p 307-321, 1979. 3 Fig, 1 Tab, 35 Ref.

Descriptors: *Lakes, *Rotifers, *Fecundity, *Size, *Food abundance, Pelagic zone, Zooplankton, Trophic level, Foods, Dissolved oxygen, Oxygen, Productivity, Length, Correlation analysis, Speciation, Pomeranian Lake region(Poland), Poland.

Investigations of 30 Polish lakes in the Pomeranian region June-July 1975 demonstrate that under natural conditions even when lakes are not much different with regard to food resources, food is a significant factor controlling rotifer fecundity and size. Oxygen deficit in hypolimnion layers was treated as a basic trophic index and thus of lake biological production and food resources. Both June and July populations exhibit very high fecundity variations. Polyarthra sp had the highest variability range and highest average fecundity. With increasing food resources, fecundity of Keratella cochlearis, K. quadrata and Polyarthra sp increased, whereas Kellicottia longispina fecundity decreased. K. cochlearis and Polyarthra sp fecundity depended mostly on food abundance. With increasing food supply, rotifer body length decreased. K. cochlearis and K. quadrata size changed the most; K. longispina size changed only slightly. Average body length of K. cochlearis in July was 11.4% smaller than in June; K. quadrata decreased analogously by 7.2% and K. longispina by only 1.9%. The Pomeranian lake region has no oligotrophic lakes; however, the trophic index, oxygen deficit, ranged 15.5% to 97.4% in June. (Danovich-Wisconsin)
W80-04451

MECHANISMS OF RAPID PHOTOSYNTHETIC ADAPTATION IN NATURAL PHYTOPLANKTON COMMUNITIES. I. REDISTRIBUTION OF EXCITATION ENERGY BETWEEN PHOTOSYSTEMS I AND II,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
W. F. Vincent.
Journal of Phycology, Vol 15, No 4, p 429-434, December 1979. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Phytoplankton, *Light intensity, *Lake Windermere(Great Britain), *Photosynthesis, *Adaptation, Lakes, Chlorophyll, New Zealand, Fluorescence, Trophic level, Aquatic plants, Irradiation, Bioluminescence, Light, Surfaces, Light penetration, Population, Metabolism, Plant physiology, Great Britain.

Intensities of in-vivo chlorophyll fluorescence were recorded for water columns of six (New Zealand, England) lakes of different trophic status and phytoplankton composition. Decreased yields in chlorophyll fluorescence were recorded in surface waters of all lakes, irrespective of trophic status or location. Beyond a threshold light level in each lake, fluorescence light decreased with increasing light intensity. For five New Zealand lakes, which were all surveyed in late winter under the same irradiance conditions (1500 microEin/sq m/second), all threshold light intensities lay within 54-62% of surface illuminance. The time course of fluorescence depression and recovery process was examined with Lake Windermere (England) samples. Fluorescence exponentially decreases upon exposure to bright light, the response is 100% (5 m samples) and 83% (dim light-adapted 0 m samples) complete within 2 minutes. Chlorophyll fluorescence values increase in dim light after a lag of 60 seconds; the rate of increase decreases exponentially with time. Deep (6.5 m) populations from Lake Windermere exhibit time-dependent variations in chlorophyll fluorescence over the first 25 seconds of exposure to 450 nm light. These observations are interpreted in terms of decreased spillover from photosystem II to photosystem I with increasing depth, to a minimum at threshold light intensity below which cells are in light state I. (Harris-Wisconsin)
W80-04452

SUBFOSSIL CHIRONOMIDS AS EVIDENCE OF EUTROPHICATION IN EKOLN BAY, CENTRAL SWEDEN,
National Swedish Environment Protection Board, Uppsala. Limnological Survey.
T. Wiederholm, and L. Eriksson.
Hydrobiologia, Vol 62, No 3, p 195-208, February 1979. 7 Fig, 3 Tab, 23 Ref.

Descriptors: *Ekoln Bay(Sweden), *Cores, *Sediments, *Trophic level, *Chironomidae, *Paleolimnology, Lake Malaren, Sweden, Eutrophication, Tubificids, Benthic fauna, Diptera, Limnology, History, Paleohydrology, Nutrients, Ecology, Ecosystems, Chlorophyll, Distribution, Speciation, Phosphorus, Nitrogen, Fertilizers.

Stratification of chironomid head capsules within three 65-76 cm sediment cores taken from Ekoln Bay, a highly eutrophic basin in Lake Malaren, central Sweden, reflects the lake's trophic status over the past 150 years. Successive but slow eutrophication due to more intensive land use occurred from the 1800's to 1920's. A more rapid change in trophic conditions resulting in bottom water oxygen depletion occurred 1940-1950. Changes were presumably caused by increased sewage load-

ing and more extensive use of commercial fertilizers in agriculture. Highly eutrophic conditions continued until recent years. With information from numerous Swedish lake studies, subfossil chironomid assemblages were used to estimate nutrient and chlorophyll levels in Ekoln Bay during different time periods. Reducing nutrient loading through advanced sewage treatment would half phytoplankton biomass from that occurring during the last ten years. Sediment cores revealed 819 individuals distributed over 21 genera. Phaenopsectra, Chironomus and Procladius account for 65% of the material; Micropsectra and Tanytarsus make up an additional 25%. Micropsectra and Phaenopsectra are strongly associated with oligotrophic-mesotrophic conditions. In the top 20 cm Chironomus and Procladius were by far the most abundant taxa. (Danovich-Wisconsin)
W80-04453

PHOSPHATE REQUIREMENT OF ANABAENA OSCILLARIOIDES AND ITS ECOLOGICAL IMPLICATIONS,
Auckland Univ. (New Zealand). Dept. of Botany.
C. W. Y. Lam.
Hydrobiologia, Vol 67, No 1, p 89-96, November 1979. 5 Fig, 2 Tab, 32 Ref.

Descriptors: *Anabaena, *Nutrient requirements, *Phosphates, *Waikato River(New Zealand), Cyanophyta, Algae, Phosphorus, Ecology, Environmental effects, Laboratory tests, Cytological studies, Cultures, Growth rates, Enzymes, Limiting factors, Metabolism, Plant physiology, Population, Primary productivity, New Zealand.

Anabaena oscillarioides when grown in filtered water from the Waikato River, New Zealand, produces well-recognized phosphorus (P)-deficiency symptoms such as high alkaline phosphatase activity and low intracellular P content, indicating that the river phosphate content is inadequate to support good algal growth. With phosphate supplements, all P-deficiency characteristics disappear, confirming that phosphate is the limiting nutrient for Anabaena in the Waikata River. Filtered river water supplemented with 1000 micro g P/l above ambient levels, sustains a much higher Anabaena growth (5.1 million cells/ml) when compared with ambient river water (1.8 million cells/ml) after eight days growth. The highest intracellular P content in P-supplemented algae is 0.066 micron micro g P/cell and in ambient water 0.0094 micron micro g P/cell; the minimum P content in inoculum algae is 0.0016 micron micro g P/cell. Rinal algal yields increase with phosphate-P concentrations 0-100 micro g/l; beyond 100 micro g/l, increases in phosphate concentrations do not affect the growth rate significantly but do increase final algal yields. Ks, the half-saturation constant, is 67 micro g/l; this low phosphate affinity probably does not allow algal growth to proceed at high rates. When river water is supplemented with 100 micro g P/l, doubling time is reduced from two days to 0.5 days. (Danovich-Wisconsin)
W80-04454

DIATOM ASSOCIATIONS AND SUCCESSION IN LAKE KARIBA, SOUTH CENTRAL AFRICA,
University of the Witwatersand, Johannesburg (South Africa).
F. D. Hancock.
Hydrobiologia, Vol 67, No 1, p 33-50, November 1979. 8 Fig, 1 Tab, 31 Ref.

Descriptors: *Diatoms, *Succession, *Speciation, *Lake Kariba, Africa, *Spatial distribution, *Lake basins, Plankton, Algae, Distribution, Seasonal, Melosira, Limnology, Lake morphology, Biomass, Water temperature, Dominant organisms, Hydroelectric plants, Dams, Pondage, Population, Zambesi River(Africa), Africa, Zambia, Rhodesia.

Except for the northeast Sanyati sub-basin (part of Lake Kariba, a very large lake formed between Zambia and Rhodesia for hydroelectric power) diatom associations show a gradual change from upper to lower lake and basin individuality is not evident. Kariba was studied 1959-1972 and diatom associations were analyzed in relation to the thermal cycle in different lake basins. A dominant association composed of Melosira granulata, M. granulata angustissima and M. distans alpigena demonstrate a succession pattern. The first two species, by variations in their percentage occurrence, show a gradual change from lacustrine conditions prevailing at the barrier area of the Sanyati basin to riverine conditions of uppermost basins. A second association formed by Cyclotella, Fragilaria and Synedra species is a regular feature of the diatom population. It is sub-dominant to the Melosira association in the barrier area but becomes more reduced in up river basins. The northeast Sanyati sub-basin disrupts the general pattern and shows individuality; accidental and ambivalent plankters are co-dominant with the Melosira association during homothermy. Lake Kariba is warm (17-32C), monomicitic and mesotrophic. Upper basins are influenced by Zambesi River, the lower basins by climatic conditions. Overturn commences in March in riverine basins and in May at the barrier with 21-22C average water temperatures. Stratification commences in upper basins in June and occurs in August in lower basins. (Danovich-Wisconsin)
W80-04455

STEADY-STATE GROWTH AND CHEMICAL COMPOSITION OF THE MARINE CHLOROPHYTE DUNALIELLA TERTIOLECTA IN NITROGEN-LIMITED CONTINUOUS CULTURES,
Woods Hole Oceanographic Institution, MA.
J. C. Goldman, and D. G. Peavey.
Applied and Environmental Microbiology, Vol 38, No 5, p 894-901, November 1979. 6 Fig, 2 Tab, 35 Ref. NOAA 04-8-M01-149 and NSF OCE-7819420.

Descriptors: *Cultures, *Limiting factors, *Nitrogen, *Chlorophyta, *Growth rates, *Laboratory tests, Carbon, Phosphorus, Marine algae, Equations, Culture media, Nutrients, Chemical properties, Phytoplankton, Dunaliella tertiolecta, Nitrates, Ureas, Nitrites, Ammonia, Cytological studies.

Continuous-culture experiments of marine chlorophyte Dunaliella tertiolecta under ammonia-, nitrate-, nitrite- and urea-N limitations show that this species can adapt to exploit different potentially available nitrogen (N) sources in natural water without appreciable differences in growth rates. The highest dilution rate which maintains a steady-state population is 1.33/d. Nitrogen cell quota (Q-n) varies from 1.3 pg of N/cell (k-Q) at zero growth rate (u=0) to 7.0 pg of N/cell (Q-m) at a maximum growth rate (u-max). Under enriched batch conditions, Q-m is 8.8 pg of N/cell. Specific growth rate is 1.66/d. The ratio between the minimum cell quota (k-Q) and maximum cell quota (Q-m) is 0.19; therefore, there is no substitute for determining u-max experimentally. Trends in carbon (Q-c) and phosphorus (Q-p) cell quotas with varying steady state growth are very similar: virtually no effect of growth on either cell quota up to u=1.1/d (=0.8 u-max), followed by very rapid increase up to u-max, indicating that a threshold value must be reached before growth occurs. Values of u-max are similar when determined either by cell washout technique or batch growth in enriched medium. Results indicate physiological limits in cellular constituency under N limitation; however, this information does not provide clues to natural population responses to nutrient exposures which vary temporally and spatially on a microscale. (Danovich-Wisconsin)
W80-04456

FACTORS CAUSING ELEVATED BIOLOGICAL OXYGEN DEMAND IN THE LITTORAL ZONE OF LAKE WINGRA, WISCONSIN,
Wisconsin Univ., Madison. Dept. of Botany.
S. R. Carpenter, A. Gurevitch, and M. S. Adams.
Hydrobiologia, Vol 67, No 1, p 3-9, November 1979. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Biochemical oxygen demand, *Littoral, *Lake Wingra(WI), *Macrophytes, *Leachate, *Eutrophication, Pelagic zone, Organic matter, Myriophyllum spicatum, Nitrates, Ammonia, Phosphates, Correlation analysis, Organic compounds, Inorganic compounds, Phosphorus, Water temperature, Aquatic weeds, Carbon, Decomposing organic matter, Wisconsin.

High BOD values that occur in filtered littoral waters in Lake Wingra, Wisconsin are due primarily to greater concentrations of labile dissolved organic carbon, and secondarily to greater dissolved phosphate concentrations. Increased organic carbon accounts for most of the increased oxygen uptake, although phosphate stimulates BOD to some degree. Lake Wingra weedbeds add labile dissolved organic carbon to littoral waters. Between June and September, littoral BOD averages 0.31 mg/l higher than that of pelagic water. Effects of several environmental factors (water temperature; phosphate, nitrate or ammonia concentrations; and dissolved organic matter from decaying macrophytes) on BOD in filtered Lake Wingra water was examined. Low correlation was observed between BOD and water temperature. Although inorganic phosphorus does not significantly correlate with BOD in field data, phosphate has a small but significant effect on BOD in enrichment experiments. Dissolved organic phosphorus significantly correlates with BOD in field data; enrichment with macrophyte leachate markedly affects BOD. Nearly all macrophyte leachate oxidizes during BOD incubations. BOD is not influenced by nitrate or ammonia enrichments. Lake Wingra is a hardwater eutrophic lake with 2.4 m mean depth. Dense week beds dominated by Myriophyllum spicatum (Eurasian water-milfoil) cover a third of the lake's surface. (Danovich-Wisconsin)
W80-04457

A COMPENDIUM OF LAKE AND RESERVOIR DATA COLLECTED BY THE NATIONAL EUTROPHICATION SURVEY IN EASTERN NORTH-CENTRAL, AND SOUTHEASTERN UNITED STATES.
National Eutrophication Survey, Corvallis, OR. Working Paper No 475, September 1978. 268 p.

Descriptors: *Basic data collections, *National Eutrophication Survey, *Lakes, *Regions, *Reservoirs, *Trophic level, Atlantic coastal plain, Central U.S., Appalachian Mountain region, Northeast U.S., Southeast U.S., Eutrophication, Mesotrophy, Oligotrophy, Lake morphometry, Physicochemical properties, Biological properties, Cycling nutrients, Nonpoint sources, Nutrients, Data collections.

Individual lake and reservoir reports for 153 bodies of water in 17 eastern U.S. states include data on trophic conditions; nutrient sources, loads and controllability; and limiting nutrients. Each report also includes National Eutrophication Survey (NES) data pertaining to the water body, the drainage area, and nutrient point sources. To make NES data accessible to many users, data in each lake report are summarized and include information on water bodies sampled during the second year of the survey. States included here are Alabama, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Maryland, Mississippi, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia. Trophic conditions for each lake are based on an assessment of data collected during the sampling year supplemented by results of past studies, if any, and communications with state personnel. Each water body is characterized either as 'oligotrophic' (implying low nutrient levels and productivity), 'eutrophic' (with high nutrient levels and productivity), 'mesotrophic' (with moderate nutrient levels and productivity) or 'hypereutrophic' (with very high nutrient levels and productivity). For large water bodies, two or more trophic categories are sometimes indicated. Data are arranged in five categories: (1) morphometry, (2) physical and chemical characteristics, (3) biological characteristics, (4) nutrient loading characteristics, and (5) nonpoint source nutrient export. (Harris-Wisconsin)
W80-04458

A TIME- AND DEPTH-DEPENDENT MODEL FOR PHYSICAL, CHEMICAL AND BIOLOGICAL CYCLES IN TEMPERATE LAKES,

Washington Univ., Seattle. Dept. of Oceanography.
R. A. Walters.
Ecological Modelling, Vol 8, p 79-96, January 1980. 5 Fig, 1 Tab, 36 Ref.

Descriptors: *Mathematical models, *Mixing, *Physical properties, *Biological properties, *Lakes, *Temperate, *Primary productivity, Stimulation analysis, Turbulence, Cycles, Water temperature, Thermal stratification, Mathematical studies, Equations, Lake Washington(WA), Chemical properties, Cycling nutrients, Phytoplankton, Growth rates, Time, Depth, Diffusion.

A model has been developed in which eddy diffusion of algal cells and dissolved nutrients is consistent with mixing processes which influence the thermal structure of the lake. Using standard modeling formulations for net production, respiration and nutrient uptake, results show that chlorophyll-a and nutrient distributions are controlled to a large extent by turbulent mixing processes considered in the thermal model. The thermal model follows the general approach of Sundaram and Rehm which leads to a physically realistic description of temperature structure, particularly around the start of stratification in spring. The general biological model considers dependent variables as continuous in space and time, and details nutrient movements within lakes. The biological production model is formulated in terms of paired, coupled, nonlinear partial differential equations governing chlorophyll-a and dissolved phosphorus distributions. The equations are solved by finite differences and iteration techniques. A number of formulations for eddy diffusivity in the epilimnion and hypolimnion were evaluated and the results are compared with 1963 data for Lake Washington, Washington. Simulation results compare favorably with measured distributions in Lake Washington. It concludes that a close relationship can exist between the stratification cycle and algal-nutrient distributions. The numerical model was developed to study complex relationships between physical, chemical and biological processes occurring in many deep, stratified temperate lakes. (Danovich-Wisconsin)
W80-04460

A COMPUTATIONAL MODEL FOR GROWTH AND HARVESTING OF THE MARINE ALGA ASCOPHYLLUM NODOSUM,
Central Inst. for Industrial Research, Oslo (Norway).
K. L. Seip.
Ecological Modeling, Vol 8, p 189-199, January 1980. 5 Fig, 2 Tab, 28 Ref.

Descriptors: *Norway, *Harvesting of algae, *Cutting management, *Mathematical models, *Vegetation regrowth, Ascophyllum, *Algae, Growth rates, Harvesting, Time, Productivity, Biomass, Natural resources, Resources management, Mortality, Density, Curves, Long-term planning, Aquatic weeds, Marine algae, Simulation analysis.

A simulation model for the growth and harvesting of marine alga Ascophyllum nodosum in northern and western Norway shows that yield depends upon environmental factors and on harvesting procedures. For a given area and a given technology, the optimum harvesting strategy is determined in terms of harvesting frequency and cutting degree. Two different harvesting strategies are developed, one giving high instantaneous yield and the other giving high long-term yield. The latter incorporates elements of counterintuitivity on a practical level, but this strategy is preferred as new and more efficient algal cutting devices are introduced. At frequent harvesting intervals substantially less algal biomass should be removed than is technologically feasible with current implements. For each choice of regrowth period, an optimum cutting degree is found with respect to long-term yield. At periods of two, three and four years, a base vegetation of 20%-30%, 8%-10% and 3%-4% should be left for regrowth, respectively. A full size plant takes 5-8 years to grow. Annual mortality rates vary depending upon locality and climatic changes. A significant increase in average mortality occurs along a gradient from sheltered localities (20% mortality) to exposed localities (40% mortality). Yields increase by 50% when mortality decreases 40%-18% with a traditional cutting degree of 2% carrying capacity. Brown alga Ascophyllum is used in Norway as manure, animal fodder and raw material for seaweed meal and other industrial products. (Danovich-Wisconsin)
W80-04461

ULTRAVIOLET RADIATION AND PHYTOPLANKTON PHOTOSYNTHESIS,
Washington Univ., Seattle. Dept. of Oceanography.
C. J. Lorenzen.
Limnology and Oceanography, Vol 24, No 6, p 1117-1120, November 1979. 2 Fig, 9 Ref. NSF DES 74-00653A1.

Descriptors: *Phytoplankton, *Photosynthesis, *Ultraviolet radiation, *Coasts, *Oceans, Environmental effects, Puget Sound(WA), Pacific Ocean, Africa, Light, Radiation, Depth, Electromagnetic waves, Solar radiation, Euphotic zone, Ozone, Algae, Metabolism, Plant physiology.

Effects of present-day ultraviolet-B (290-320 nm) levels on phytoplankton photosynthesis and possible effects of elevated UV-B levels are assessed; UV-B removal increases C-14 incorporation and threshold levels occur at rather low absolute values. Therefore, a reasonable fraction, even up to 50%, of the euphotic zone experiences photosynthetic activity suppression due to natural present-day UV-B levels. Doubling of UV-B affects a layer 4.6 m and 0.2 m for oceanic and coastal waters, respectively. Observations were taken at four geographical locations: Puget Sound; shelf waters off the Washington coast; open ocean in the North Pacific; and shelf waters off northwest Africa. In coastal waters with 5 m euphotic zone, differences in C-14 uptake are detected at 1.2-1.5 m; this corresponds to 0.1-0.01% surface UV-B levels. In open ocean waters, a larger fraction of the euphotic zone is similarly affected. A sunburning radiation of 600 counts/30 min corresponds to UV-B levels experienced at local apparent noon when total incident radiation is 1.25 ly/min. Effects of UV-B levels on photosynthesis probably does not alter data on estimates of oceanic production. However, UV-B effects are important when discussing vertical structures of phytoplankton populations since production estimates in the upper 1/6-1/10 of the euphotic zone are significantly overestimated. Lethal limit of UV-B to algal cells, variability in algal genetic pool in its resistance, repair capability, and the magnitude of vertical mixing in upper euphotic layers are still unknown. (Danovich-Wisconsin)
W80-04462

AN ANALYTICAL INTEGRATION METHOD OF COMPUTING DIURNAL PRIMARY PRODUCTION FROM STEELE'S LIGHT RESPONSE CURVE,
Stockholm Univ. (Sweden). Dept. of Zoology.
A. Engqvist, and S. Sjoberg.
Ecological Modeling, Vol 8, p 219-232, January 1980. 4 Fig, 1 Tab, 11 Ref, 1 Append.

Descriptors: *Light, *Primary productivity, *Curves, *Mathematical studies, *Methodology, Photosynthesis, Analytical techniques, Diurnal, Mathematical models, Ecosystems, Phytoplankton, Aquatic environment, Equations, Time, Depth, Seasonal, Computers, Simulation analysis, Ecology.

Exact time integrals of both Steele's original function and its depth integrated version are deduced analytically, assuming a sinusoidal diurnal variation in light; this method of analytical integration is advantageous in combining high numerical accuracy with comparatively little computational effort. The photosynthesis-light response is an important process in all mathematical models of phytoplankton primary production in aquatic habitats. Steele's mathematical formulations are simple; only one parameter is required to determine the general shape of the light-response curve. Its explicit depth and time integrals are stated but only approximate and/or graphic solutions are attempted for its integration in time. An exact analytical solution is presented as well as an efficient algorithm for its numerical evaluation. The method is tested in a sample diurnal ecosystem simulation. Most primary production takes place in 0-10 m, independent of season; very little production occurs below 20 m. Diurnal production in the mixed layer predicted by Steele's formula is a hyperbolic of light intensity at midday. Production differences at different seasons with the same light intensity at noon, result mainly from different photoperiod lenghts. For winter solstice, equinox and summer solstice, numerical integration with trapezoidal rules requires one and a third, twice and three times more computing time, respectively, to obtain corresponding curves with the same accuracy as analytical integration methods. (Danovich-Wisconsin)
W80-04464

APPLICABILITY OF CELLULAR EQUILIBRIUM AND MONOD THEORY TO PHYTOPLANKTON GROWTH KINETICS,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
D. M. Di Toro.
Ecological Modeling, Vol 8, p 201-218, January 1980. 4 Fig, 2 Tab, 20 Ref, 1 Append. EPA R803030.

Descriptors: *Nutrients, *Phytoplankton, *Growth rates, *Kinetics, *Monod equation, *Equilibrium, *Metabolism, Nutrient requirements, Michaelis-Menten equations, Biochemistry, Mathematical studies, Biomass, Algae, Cycling nutrients, Approximation method, Population dynamics, Equations, Plant physiology, Cytological studies.

Two classes of kinetics are currently applied to phytoplankton growth: Monod theory states that growth rates depend on external nutrient concentrations while other formulations (Droop, Caperon) emphasize that growth rates depend on internal cellular nutrient concentrations. The more realistic case, in which both internal and external concentrations control uptake, is compared to Monod's growth theory and at steady-state with an appropriate definition for the half-saturation constant, results are essentially equivalent. Variable cellular nutrient concentrations still imply that nutrient stoichiometric ratios change in response to changing external concentrations. However, an important simplification is still possible. Relatively small errors are introduced if internal cellular concentration is assumed to be in dynamic equilibrium with external concentrations. This cellular equilibrium approximation is essentially a computational simplification. It has advantages since no new dynamic state variables are introduced into the formulation. The rapid dynamics of internal cellular concentrations are eliminated which in turn removes the possibility of cells having different internal concentrations within a volume segment since in this approximation, cells equilibrate immediately as they are transported to other volume segments. Computational results indicate cellular equilibrium approximations are adequate when considering nutrient flux to bottom sediments via algal settling if substrate concentration change rates are slow relative to phytoplankton growth rates. (Danovich-Wisconsin)
W80-04465

A RECIPE FOR BAD WATER: WELFARE ECONOMICS AND NUISANCE LAW MIXED WELL,
Franklin Thomas Backus Law School, Cleveland, OH.
For primary bibliographic entry see Field 6E.
W80-04469

5D. Waste Treatment Processes

ANAEROBIC-ACTIVATED CARBON FILTERS FOR THE REMOVAL OF REFRACTORY AND TOXIC ORGANIC COMPOUNDS IN WASTEWATER,
Georgia Inst. of Tech. Atlanta. School of Civil Engineering.
M. T. Suidan, W. H. Cross, M. Fong, J. W.

Calvert, and K. A. Khan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164254, Price codes: A09 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology Technical Completion Report No ERC 08-79, November 1979. 176 p, 62 Fig, 22 Tab, 113 Ref. OWRT A-077-GA (1).

Descriptors: *Waste water treatment, *Phenols, *Anaerobic conditions, *Activated carbon, *Carbon filters, Organic loading, Toxins, Water purification, Pollutants, Industrial wastes, Spectrophotometry, Analytical techniques, Water pollution treatment, Chemical wastes.

An anaerobic filter with granular activated carbon was developed and tested for the effective and energy efficient treatment of waste water containing phenolic compounds. Two identical experimental reactors consisting of four jacketed columns and three clarifiers connected in series were tested. Each column had a reversible recirculation pump for the recirculation of the aqueous contents around each individual reactor. Granular activated carbon served as a media for microbial attachment, substrate concentration, and polarization. A feed substrate flow rate of 2 ml/min giving a total empty bed contact time of 46.48 hours was used with a recirculation flow rate of 50 ml/min. Two phenolic compounds, catechol and o-cresol, were tested at different organic loading rates in the reactors. Three feed concentrations, 200, 400, and 1,000 mg/l, of catechol were tested. For all three satisfactory steady state removal efficiencies were obtained for total organic carbon (81 to 94%), for chemical oxygen demand (88 to 94%), and for catechol (98 to 99%). The system exhibited stability to suddenly increased feed catechol concentrations by increased production of gas. Results were not as positive for the treatment of o-cresol bearing synthetic waste water. Only adsorption onto the activated carbon packing was obtained with no degradation of the o-cresol. While this study showed the potential of the anaerobic-activated carbon filter in the treatment of phenolic compounds, more investigation is recommended. (Seigler-IPA)
W80-04205

IMPROVEMENT OF THE QUALITY OF WASTE POND EFFLUENTS IN NORTHERN AREAS BY CHEMICAL PRE-PRECIPITATION,
Oulu Univ. (Finland). Water Research Lab.
J. U. Airaksinen.
Progress in Water Technology, Vol 10, No 6, p 899-906, 1978. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Finland, *Winter, *Chemical precipitation, *Waste water treatment, *Water temperature, *Costs, Biochemical oxygen demand, Effluents, Water quality, Water pollution control, Waste storage, Phosphorus, Economic efficency, Ponding, Ponds, Sludge disposal, Construction costs, Operating costs, Ii(Finland).

Investigations on several ponds in northern Finland 1974-1976 showed that chemical pre-precipitation increased BOD and phosphorus (P) removals; overall BOD removal rate became 2.5-fold. Study results also show that treatment efficiency decreases with reduced pond temperature as the freezing point is approached. Waste ponding is often the most economical method of treating wastewater; however, in winter with water temperatures 0-8C, ponds become anaerobic and P from bottom sludge returns into solution. The pond at Ii serves 1650 inhabitants and has 260 cu m/d average wastewater flow. Average BOD is 120 mg/l; total P and nitrogen (N) concentrations are 12.5 and 58 mg/l, respectively. Two successive processes occur in the treatment pond: chemical precipitation and biological treatment. Pre-precipitation basins have 300 cu m volume and coagulation is carried out with 230 g/cu m ferric chloride. Due to the use of chemicals and pre-precipitation, BOD removal efficiency increases 53%-84% and total P removal 11%-73%. N reduction is only 20%-30%. Total per-capita construction costs of the improved ponds are $20-$30 of plant costs applying simultaneous precipitation. Chemical precipitation creates large quantities of sludge. Evacuators and pumps are used to remove sludge for communities with more than 500 inhabitants. For smaller communities, a movable belt filter jointly owned by 5-6 communities is the best solution. (Danovich-Wisconsin)
W80-04287

ION EXCHANGE RECOVERY OF COBALT AND COPPER FROM BLACKBIRD MINE DRAINAGE,
Idaho Univ., Moscow. Water Resources Research Inst.
K. A. Prisbrey, J. F. Williams, and H. Lee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-166457, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute. University of Idaho Research Technical Completion Report, January 1980. Presented at the 109th Annual AIME Meeting, Las Vegas, NV, February 24-28, 1980. 25 p, 14 Fig, 2 Tab, 10 Ref. OWRT A-067-IDA(1).

Descriptors: *Cobalt, *Acid mine water, *Mine drainage, *Ion exchange, Water purification, Copper, Idaho, Salmon, Rainbow trout, Spawning, Water pollution sources, Laboratory tests, Flow rates, Mathematical models, Mine wastes, Mining.

The use of gravity flow ion exchange resin beads to reduce acid mine drainage water pollution from the Blackbird Mine, a cobalt mine near Cobalt, Idaho, was examined. The mine is currently closed but, due to international cobalt trade disruptions, the Noranda Mining Company is interested in reopening the mine. The mine is located in a high mountain pass and acid drainage leaks into the Panther Creek drainage system are creating lethal conditions for salmon and steelhead for over 20 miles downstream. Bucktail Creek receives the polluted water and during the early spring it contains 274 ppm of copper and 51 ppm of cobalt, both of which are toxic to aquatic life. Conventional methods for controlling this pollution source are not feasible due to the mountain location and lack of power for equipment operation. Several kinds of ion exchange beads were considered and a macrocreticular weakly acid cation exchanger in sodium form with carboxylic functionality was found to reduce cobalt and copper concentrations to less than 0.1 ppm in creek water. The tough methacrylic acid copolymer provides long life while the large discrete pores allow for easy cation entry and adsorption. Laboratory tests performed on the beads include: equilibrium tests, rate studies on artificial solutions, and rate studies on creek water samples. Field tests were also conducted. A film diffusion model was developed to describe the rate data. (Seigler-IPA)
W80-04296

TREATABILITY OF CARCINOGENIC AND OTHER HAZARDOUS ORGANIC COMPOUNDS,
IIT Research Inst., Chicago, IL.
E. G. Fochtman, and W. Eisenberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-11683, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-097, August 1979. 68 p, 4 Fig, 9 Tab, 26 Ref, 2 Append. CI-68-03-2559.

Descriptors: *Organic compounds, *Waste water treatment, *Ozone, *Biodegradation, *Carbon filters, Oxidation, Water pollution treatment, Chemical degradation, Biological treatment, Sewage treatment, Activated carbon, Gas chromatography, Spectrophotometry.

The treatability of five chemical carcinogens in waste water by three treatment methods, biodegradation, carbon adsorption, and ozone oxidation, was examined. The chemical carcinogens tested were: naphthalene (NAP); 1, 1-diphenylhydrazine (DPH); beta-naphthylamine (BNA); 4, 4(1)-methylene-bis (2-chloroaniline) (MOCA); and dimethylnitrosamine (DMNA). The carcinogens were tested at levels of 1 mg/l or less in mineralized distilled water contaminated with the compounds. Both static and continuous reactors were used in the biodegradation tests. For the carbon adsorption tests two commercially available granular activated carbons were used, Filtrasorb 400 and Darco KB. A 12-liter reactor with 1 percent ozone in oxygen was used for the ozone oxidation studies. Analytical techniques used include high performance liquid chromatography, ultraviolet adsorption, high resolution gas chromatography, and spectrophotometric analysis. Results show that NAP can be successfully treated by all three techniques but reaction with ozone occurs slowly. The three carcinogens DPH, BNA, and MOCA can also be treated by all three processes. DMNA is biodegradable in continuous biological reactors but it resists ozone oxidation and is not adsorbed by carbon. Data from study results are given. (Seigler-IPA)
W80-04298

IMPACT OF THE 1977 CLEAN WATER ACT AMENDMENTS ON INDUSTRIAL DISCHARGERS,
Morgan, Lewis and Bockius, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04487

5E. Ultimate Disposal Of Wastes

ACTIVE WASTE-INJECTION SYSTEMS IN FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-04368

IMPACT OF THE 1977 CLEAN WATER ACT AMENDMENTS ON INDUSTRIAL DISCHARGERS,
Morgan, Lewis and Bockius, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04487

5F. Water Treatment and Quality Alteration

RESTORATION OF LAKE NAKSKOV INDREFJORD, DENMARK, USING ALGAL PONDS TO REMOVE NUTRIENTS FROM INFLOWING RIVER WATER,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
N. Nyholm, P. E. Sorensen, K. Olrik, and S. D. Pedersen.
Progress in Water Technology, Vol 10, No 6, p 881-892, 1978. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Lake Nakskov Indrefjord(Denmark), *Water pollution control, *Nutrient removal, *Phosphorus, *Nitrogen, *Lake restoration, Algae, Nutrients, Effluents, Phytoplankton, Fish, Predation, Zooplankton, Aluminum sulfate, Flotation, Sedimentation, Filtration, Eutrophication, Water quality, Chemical precipitation, Costs, Denmark.

Experiments on lake restoration techniques for Lake Nakskov Indrefjord, Denmark, summer 1974 and 1976, showed that the best method is based on algal separation by alum coagulation followed by dissolved air flotation. Efficient algal separation occurs when alum is used alone without pH adjustment or addition of polymers as a coagulation aid. Phosphorus is reduced 91-93%, resulting in a 0.1 mg/l total phosphorus effluent concentration. Water passage through the algal pond also removes almost 100% of the dissolved nitrogen. Nakskov Indrefjord eutrophication is caused by high nutrient contents from two inflowing rivers, Halsted and Ryde. River water was continuously pumped through two pilot ponds May-October 1976. In Danish climate, algal ponds function only during summer months. In order to avoid zooplankton blooms one of the ponds was stocked with 325 small crucian carps. In the pond without fish, zooplankton predominated and phytoplankton numbers were small, using up little nitrogen. In the pond with fish, sufficient phytoplankton growth took place to make nitrogen growth-limiting. Phosphorus, present in excess, was controlled by

alum coagulation. Sedimentation and filtration methods were examined and also were satisfactory. Construction costs for an algal pond with chemical precipitation and flotation are estimated at $1.1 million. (Danovich-Wisconsin)
W80-04288

WATER QUALITY COMMITTEE-ANNUAL REVIEW OF SIGNIFICANT LEGISLATURE, JUDICIAL AND ADMINISTRATIVE, ACTIVITIES DURING 1977.
American Bar Association, Washington, DC. Natural Resources Law Section.
For primary bibliographic entry see Field 6E.
W80-04472

IMPACT OF THE 1977 CLEAN WATER ACT AMENDMENTS ON INDUSTRIAL DISCHARGERS,
Morgan, Lewis and Bockius, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04487

FEDERAL COMMON LAW: JUDICIALLY ESTABLISHED EFFLUENT STANDARDS AS A REMEDY IN FEDERAL NUISANCE ACTIONS,
For primary bibliographic entry see Field 6E.
W80-04499

5G. Water Quality Control

SOURCES OF PHOSPHORUS IN THE LOUGH NEAGH SYSTEM AND THEIR REDUCTION,
Ministry of Agriculture, Crumlin (Northern Ireland). Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 5B.
W80-04227

HYBRID APPROACH IN WATER QUALITY MANAGEMENT,
Goettingen Univ. (Germany, F.R.). Fachbereich Physik.
G. Romberg.
Progress in Water Technology, Vol 11, No 6, p 531-549, 1979. 12 Fig, 3 Tab, 7 Ref.

Descriptors: *Water pollution, *Rivers, *Model studies, Mathematical models, Hydraulic models, Pollutants, Organic matter, Oxygen, Dissolved oxygen, Water quality, Water treatment, Waste water(Pollution), Water pollution control, Analytical techniques, Systems analysis, Hybrid approach, River pollution.

A combination of a mathematical and a physical model (hybrid model) was presented as a tool to practice the following river water quality policies: (1) Water quality standards were designated as upper limits for wasteloads of the river water and as a lower limit on dissolved oxygen in the river water. The pollution introduced into the receiving waters must be controlled in order that these standards be met. (2) A waste discharge pricing policy was recommended. In this policy, each discharger has to pay in proportion to the amount of water quality degradation he causes. The river pollution was assumed to be due to discharges from waste treatment plants. The hybrid approach predicted the water quality degradation due to each discharger separately and allowed to model the following strategies to cope with violations of water quality standards: (1) change of discharge locations, (2) reduction of emission rates including a rollback strategy defined by an optimization problem, and (3) changing the seed of nearfield mixing regions. The effectiveness of these strategies was demonstrated on a special prototype system. (Sims-ISWS)
W80-04256

MODELLING NITRATE CONCENTRATIONS IN PUMPED STORAGE RESERVOIRS,
Ministry of Works and Development, Hamilton (New Zealand). Hamilton Science Centre.
J. C. Rutherford, and J. M. Davis.
Progress in Water Technology, Vol 11, No 6, p 327-336, 1979. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Reservoirs, *Pumped storage, *Nutrient removal, *Nitrates, Rivers, Lakes, Model studies, Mathematical models, Water temperature, Nutrients, Sodium, Potassium, Magnesium, Nitrogen, Algae, Water quality, Public health, *England.

During autumn and winter, nitrate concentrations exceed WHO limits in some British rivers used for water supply thereby posing a health hazard. Pumped-storage reservoirs act as buffers between raw water supplies and treatment plants attenuating peaks in river nitrate concentration by dilution and removing nitrate by biological processes. This potential could be exploited more fully with the aid of a mathematical model describing nitrate concentration changes which result from inflow, outflow, and biological removal. A zero-dimensional model was found adequate to describe weekly changes in nitrate concentration in two British reservoirs. The model was calibrated on each reservoir separately using one year of data, and then reproduced concentrations in other years with root mean square errors between 12% and 50% of the observed median. Model coefficients for the two reservoirs were significantly different, presumably because of differences in lake morphology and algal populations. This means that at present the model would need to be calibrated for each reservoir. The model can be used to prepare nomographs for a range of likely river nitrate levels, pumping rates, and seasonal temperature distributions. (Sims-ISWS)
W80-04266

HIERARCHICAL-MULTIOBJECTIVE APPROACH IN THE PLANNING AND MANAGEMENT OF WATER AND RELATED LAND RESOURCES,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Department.
P. Das.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-168818, Price codes: A14 in paper copy, A01 in microfiche. Ph.D. Dissertation, June 1976, 298 p, 11 Fig, 29 Tab, 258 Ref, Append. OWRT C-7047(No 6221)(4), 14-34-0001-6221.

Descriptors: *Water resource planning, Multiobjective optimization, Water quality, Surrogate worth trade-off method, Non-point source pollution, Biological oxygen demand, Hierarchical decomposition, Level-B planning, Pareto optimum, *Water management(Applied), *Resources development, Water resources development, *Land management.

A systematic methodological approach to the long-range planning and management of a regional water and related land resources system is presented. The needs for considering and including multiple objective functions in this noncommensurable format and units are discussed. A general multiobjective planning and management model for water and land resources is developed, considering economic development and environmental quality as the two major objectives. The economic objective constitutes the cost of point and nonpoint source pollution control, and the cost of water supply. The environmental quality model includes the following multiple objectives: (1) sediment; (2) phosphorus; (3) biological oxygen demand; and (4) dissolved oxygen deficit level in the stream. The mathematical models developed take into account the interactive nature of both ground and surface water, as well as multiple sources of pollutants from point and nonpoint sources. The Surrogate Worth Trade-off (SWT) method is used for the multi-objective analysis. Since the problem is large, hierarchical decompositions based on geographic and hydrologic boundaries are introduced. Finally, a case study problem on the Maumee River Basin is formulated and solved to illustrate the applicability and efficiency of the multiobjective planning framework developed. (Haimes-CWR)
W80-04291

NITROGEN FIXATION IN A NITROGEN-LIMITED IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W80-04360

NATIONAL WATER QUALITY INVENTORY 1976 REPORT TO CONGRESS.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 462, Price codes: A12 in paper copy, A01 in microfiche. Report No EPA-440/9-76-024, June 1977. 273 p, 6 Fig, 13 Tab, 1 Append.

Descriptors: *Water quality, *State governments, *Water pollution control, *Water Pollution Control Act Amendments of 1972(PL 92-500), Baseline studies, Water quality standards, Governmental interrelations, Federal Water Pollution Control Act, Bacteria, Heavy metals, Eutrophication, Urban runoff, Industrial water, Dissolved oxygen, Cycling nutrients, Toxins, Nonpoint sources, Point sources, Great Lakes, Regulation, Industrial wastes.

A summary of current water quality status of the states reiterates for the most part conclusions found in 1974 and 1975 national water quality inventory reports. In this update, excessive bacteria levels which limit recreational water uses are the most widely reported problem, particularly near urban areas, with high phosphorus and nitrogen concentrations also reported in many locations. Low dissolved oxygen levels are a problem primarily in smaller streams receiving large volumes of wastes. Problems with heavy metal contamination are reported by 35 states. Principal sources are industrial discharges, urban runoff and erosion of metals-rich soils and rock deposits; of these, industrial discharges and urban runoff have greatest effects on water quality. Eighteen states report problems with pesticides in water, sediments and fish tissues; but some states report significant improvements following control programs. Pollution from toxic industrial chemicals is reported by 16 states, including all those around the Great Lakes. Fourteen states expect significant improvements by 1983 under national goals posited in the Water Pollution Control Act Amendments of 1972 (PL 92-500). Although states agree with Federal authorities on a fixed schedule for future U.S. funding of municipal sewage treatment facilities, considerably less agreement occurs on future industrial discharge controls; states which discuss the issue generally do not agree with proposals to allow exemptions from 1977 level treatment requirements of PL 92-500 by the U. S. Environmental Protection Agency. (Harris-Wisconsin)
W80-04459

A REGULATED CITIZEN'S BILL OF RIGHTS,
National Oceanic and Atmospheric Administration, Washington, D.C.
For primary bibliographic entry see Field 6E.
W80-04466

WATER QUALITY COMMITTEE-ANNUAL REVIEW OF SIGNIFICANT LEGISLATURE, JUDICIAL AND ADMINISTRATIVE, ACTIVITIES DURING 1977.
American Bar Association, Washington, DC. Natural Resources Law Section.
For primary bibliographic entry see Field 6E.
W80-04472

WATER QUALITY COMMITTEE (ANNUAL REVIEW OF ACTIVITIES - 1975).
American Bar Association, Washington, DC. Natural Resources Law Section.
For primary bibliographic entry see Field 6E.
W80-04484

FEDERAL COMMON LAW: JUDICIALLY ESTABLISHED EFFLUENT STANDARDS AS A REMEDY IN FEDERAL NUISANCE ACTIONS,
For primary bibliographic entry see Field 6E.
W80-04499

NONPOINT POLLUTION CONTROL IN VIRGINIA,
For primary bibliographic entry see Field 6E.
W80-04500

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

LAND AND WATER RESOURCES PLANNING USING GOAL PROGRAMMING,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller, M. D. Dougal, and T. A. Austin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164189, Price codes: A11 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University Completion Report No ISWRRI-95, ISU-ERI-AMES-80010, July 1979. 246 p, 13 Fig, 65 Tab, 66 Ref. OWRT B-060-IA (1).

Descriptors: *Mathematical models, *Land use, *Water resources development, *Iowa, Long-term planning, Irrigation practices, Crops, Water demand, Stock water, Livestock, Land classification, Regional economics, Urbanization, Zoning.

A user-oriented goal programming (GP) model for the utilization of land and water resources for various purposes was developed and applied to a 12-county region in Northwest Iowa. The model encompases both the physical spectrum of supply and demand and the social-institutional-environmental spectrum. The model was developed from an existing computer program that was merged with additional computer code. Model development and constraints are described in detail. The model is input intensive allowing it to be flexible but some of this flexibility is lost due to the incorporation of several constraints. Inputs include run identification data, relative yield potential of corn and soybeans on a land capability class, relative yields, erosion rates, urban and rural residential land use, irrigation, and crop planting scenario. The study area in Northwest Iowa has a low annual rainfall of 25 to 28 inches per year and groundwater is not available in sufficient quantities for many uses. The area encompasses 12.8% of the total area of the state but only 10.2% of the population. Results of model application show that the water resources of the Iowa region are adequate to meet all demands with an investment of approximately one billion dollars for the construction of 24 reservoirs, thousands of wells, miles of pipeline, and several pumping stations. Goal programming was found to be a successful tool in resource planning. (Seigler-IPA)
W80-04202

HIERARCHICAL-MULTIOBJECTIVE APPROACH IN THE PLANNING AND MANAGEMENT OF WATER AND RELATED LAND RESOURCES,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Department.
For primary bibliographic entry see Field 5G.
W80-04291

COORDINATION OF OVERLAPPING HIERARCHICAL WATER RESOURCES SYSTEMS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
K. Sung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-168941, Price codes: A14 in paper copy, A01 in microfiche. PhD Dissertation, January 10, 1978. 319 p, 26 Fig, 11 Tab, 112 Ref, 3 Append. OWRT C-7047(No 6221)(3).

Descriptors: *Model studies, *Mathematical models, *Planning, *Water resources, *Optimization, Water utilization, Water resources development, Decision making, Management, Methodology, Synthesis, Theoretical analysis, Simulation analysis.

A multiobjective total system model approach to water resources planning was developed by combining three approaches to planning: the Surrogate Worth Trade-off (SWT) method, the TECHCOM approach, and the Utility Analysis approach. The SWT method, a quantitative approach, optimizes a mathematical analytical model by mathematical programming and interacts with decision makers. TECHCOM, a scenario approach, displays and analyzes information to reach the best solution for a large-scale complex system. Utility Analysis, a qualitative approach, interacts directly with decision makers to find preferences for different objectives. The multiobjective-hierarchical structure developed uses the utility approach to coordinate subsystems and hierarchical levels. SWT is used to generate a preferred solution at the highest level and then corresponding Pareto optimal solutions are subsequently determined at lower levels. Using this optimization structure many submodels are developed such as agricultural models, recreational development models, wildlife preservation models, and flooding control models. These models are used in an application of the SWT method to the Maumee River Basin Level-B Study. An analysis of the attributes of overlapping decomposition and coordination is given along with a comparison of the Dantzig-Wolfe decomposition. (Seigler-IPA)
W80-04292

A HIERARCHICAL MULTIOBJECTIVE METHOD FOR WATER RESOURCES PLANNING,
Case Western Reserve Univ., Cleveland, OH. School of Engineering.
S. C. Olenik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-168966, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, May 31, 1978. 136 p, 7 Fig, 5 Tab, 44 Ref, 2 Append. OWRT-C-7047(No 6221)(5), 14-34-0001-6221.

Descriptors: *Model studies, *Mathematical models, *Planning, *Water resources, *Optimization, Water utilization, Water resources development, Decision making, Management, Methodology, Synthesis, Theoretical analysis, Simulation analysis.

Hierarchical multiobjective optimization was used in two approaches for the possible combination of the TECHCOM methodology and the Surrogate Worth Trade-off (SWT) methodology for use by decision-makers in water resources planning. TECHCOM has a hierarchical structure (goals, subgoals, social indicators, and action variables) that preserves information at all levels so that alternatives can be analyzed without the loss of lower level information. The SWT method, which solves the standard vector optimization problem where objectives are non-commensurable, can find a preferred solution by finding Pareto-optimal solutions and tradeoffs and using systematic decision-maker input. All that is needed to generate a preferred solution is decision-maker preference input. Two sample integrations of TECHCOM and SWT were tested on a sample problem using the Maumee River Basin Level-B land resources model. One alternative, the mathematical integration alterative integrates the SWT method within the information structure of the TECHCOM goal and subgoal hierarchy. The second alternative, the operational integration alternative, features an iterative process using TECHCOM and SWT in succession. Some of the requirements for use of the combined methodology are given. Usefulness of the combined methodology depends on the complexity of the hierarchy submodels. A major advantage of TECHCOM-SWT is that it eliminates the need for a priori preference information. (Seigler-IPA)
W80-04293

A PROPOSED GROUND WATER QUALITY MONITORING NETWORK FOR IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7A.
W80-04374

CONJUNCTIVE WATER USE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-04429

A REGULATED CITIZEN'S BILL OF RIGHTS,
National Oceanic and Atmospheric Administration, Washington, D.C.
For primary bibliographic entry see Field 6E.
W80-04466

6B. Evaluation Process

IMPROVEMENT OF THE QUALITY OF WASTE POND EFFLUENTS IN NORTHERN AREAS BY CHEMICAL PRE-PRECIPITATION,
Oulu Univ. (Finland). Water Research Lab.
For primary bibliographic entry see Field 5D.
W80-04287

HIERARCHICAL-MULTIOBJECTIVE APPROACH IN THE PLANNING AND MANAGEMENT OF WATER AND RELATED LAND RESOURCES,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Department.
For primary bibliographic entry see Field 5G.
W80-04291

CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES,
Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
L. M. Cowardin, V. Carter, F. C. Golet, and E. T. LaRoe.
Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. Stock No. GPO 024-010-00524-6. Biological Services Program Report No FWS/OBS - 79/31, December 1979. 110 p, 64 Fig, 5 Tab, 120 Ref, 5 Append.

Descriptors: *Classification, *Systematics, *Wetlands, *Wildlife, *Deep-water habitats, Aquatic habitats, Marshes, Estuarine environment, Rivers, Coasts, Aquatic animals, Plant populations, Wildlife habitats, Swamps, Bogs, Deepwater.

The hierarchical classification system used in the 1974 Fish and Wildlife Service inventory of wetlands and deepwater habitats in the United States is described and illustrated from a user oriented approach. The classification system is designed so that it provides uniformity of concepts and terms, and furnishes mapping units. At the highest level of classification five systems are defined: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Marine and Estuarine systems are divided into two subsystems, Subtidal and Intertidal; Riverine systems into four subsystems, Tidal, Lower Perennial, Upper Perennial, and Intermittent; Lacustrine systems into two, Littoral and Limnetic; while only Palustrine has no subsystem. Classes, within the subsystems, may appear under one or more of the systems or subsystems. These classes are based on substrate material and flooding regime, or on vegetative life form. Necessary for use of the system are the modifying terms applied to the classes or subclasses. Classes and modifying terms are listed. The lowest level of the classification hierarchy used is the dominance type which are named for the dominant plant or animal forms and must be developed by the user of the classification system. (Stiles-IPA)
W80-04301

GROUND WATER HEAT PUMPS - A COST COMPARISON,
Wilson (Ian D.) Associates Ltd., Barrie (Ontario). D. Brown.
Canadian Water Well, Vol 6, No 1, p 20, February, 1980. 1 Fig.

Descriptors: *Heat pumps, *Ground water, *Cost comparison, Cost repayment, Costs, Fossil fuels,

Heating, Water wells, Pumping, Maintenance costs, Operating costs, Initial costs, Economics.

The ground water heat pump operates with a constant high efficiency or coefficient of performance (COP) because it taps a source of low-grade heat which is essentially unvariable. The cost of pumping water from a well to the heat pump will vary with water temperature, depth or distance to water, the particular model of heat pump used, and the amount of heat to be supplied. Although the ground water heat pump does cost more than conventional heating systems initially, the savings in operating and maintenance costs make it an economical alternative heating system for both new and old homes, especially with the high price of fuel. (Purdin-NWWA)
W80-04424

CONJUNCTIVE WATER USE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-04429

6D. Water Demand

THE POTENTIAL FOR DEVELOPING GROUND-WATER SUPPLIES IN THE PESCADERO AREA, SAN MATEO COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. P. Akers.
Geological Survey Water-Resources Investigations 80-6, January 1980. 8 p, 1 Fig, 3 Ref.

Descriptors: *Groundwater, *Water resources development, *Water supply, *California, *Groundwater availability, Potable water, Water quality, *Pescadero area(Calif), *San Mateo County(Calif).

Adequate supplies of ground water for municipal use generally are not available within a 3-mile radius of Pescadero, San Mateo County, California. The required quantity of 100 gallons per minute probably could be obtained from one or more wells in the alluvium along Pescadero Creek; however, the quality of the water probably would deteriorate with time and might not be suitable for public supply for more than 20 or 30 years. Sand and gravel beds below 60 feet in the alluvium near the junction of Honsinger and Pescadero Creeks offer the best potential for developing domestic water supplies. (Kosco-USGS)
W80-04384

TOWARD THE MAXIMIZATION OF A RESOURCE: THE 1971 WASHINGTON WATER RESOURCES ACT,
For primary bibliographic entry see Field 6E.
W80-04480

6E. Water Law and Institutions

THE EVOLUTION OF WATER QUALITY MANAGEMENT, PART 3,
R. D. Hennigan.
Clearwaters, Vol 9, No 4, p 15-19, December 1979.

Descriptors: *Federal Water Pollution Control Act, *Water pollution control, *Federal legislation, Water permits, Water quality, Administration, Water management(Applied), Toxins, Pesticides, Environmental effects, Hazards, Water quality act.

Water quality management during the period 1972-1977 shifted to a national program of preservation and conservation. As the country got over Watergate, Vietnam, and other large concerns, more and more groups became alarmed about environmental issues. Water pollution became a pressing issue with major disasters such as the finding of PCBs in the Hudson River which resulted in a fishing ban, the dumping of Kepone in the James River, and the discovery of PCB's and Mirex in the Lake Ontario fishery. A high level of public response brought about Federal action mainly in the form of the Federal Water Pollution Control Act amendments (PL 92-500), one of the most complex and comprehensive measures ever enacted by Congress. The act applied to all United States waters and made the Environmental Protection Agency (EPA) the authority for implementing the act which was designed 'to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.' To implement the act various mechanisms were used such as four levels of planning, permits, construction grants, legal sanctions, and citizen action. Other acts were also implemented to help such as the Safe Drinking Water Act; Marine Protection, Research and Sanctuaries Act; Toxic Substances Control Act. The 1972 act had many deadlines for EPA that have since been revised. As a result of the act a great deal of improvement occurred in the Nation's waters. This progress continued as the era ended with the 1977 amendments to the original act. (Seigler-IPA)
W80-04303

NATIONAL WATER QUALITY INVENTORY 1976 REPORT TO CONGRESS.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W80-04459

GROUND WATER MANAGEMENT IN GEORGIA,
Georgia Univ., Athens. Legislative Research Div.
For primary bibliographic entry see Field 4B.
W80-04463

A REGULATED CITIZEN'S BILL OF RIGHTS,
National Oceanic and Atmospheric Administration, Washington, D.C.
R. R. Gardner.
Coastal Zone Management Journal, Vol 3, No 1, p 1-5, 1976.

Descriptors: *Public rights, *Water management(Applied), *Coasts, Water policy, Permits, Coastal engineering, Developed waters, State governments, Administrative agencies, Environmental control.

Coastal zone management has become a significant area of concern at all levels of government. In times of increasing environmental and economic progmatism, coastal management programs may be perceived as a function of big government and/or antithetical to development. In order to suceed in today's environment, coastal zone management programs need general public support. To ensure the support of the average citizen, each coastal zone management program should include in its policy statement the following points: (1) comprehensive, rational regulations that can be understood by the public; (2) simple regulatory procedures whereby regulated activity is not subjected to undue inconvenience; (3) reasonable costs of application; (4) timely decisions on applications within a time specified at the time of application; (5) negotiated settlements between applicants and the regulatory agency; (6) appeals from regulatory decisions; (7) equity of treatment; and (8) courteous treatment by all members of the regulatory body. (Wilson-Florida)
W80-04466

MINING RIGHTS AND THE GENERAL INTERNATIONAL LAW REGIME OF THE DEEP OCEAN FLOOR,
Syracuse Univ., NY.
L. F. E. Goldie.
Brooklyn Journal of International Law, Vol 2, No 1, p 1-69, Fall 1975.

Descriptors: *Law of the sea, *International law, *Resources development, United Nations, International commissions, Mining, Mineral industry, International waters, Legal aspects, Subsoil, Oceans, Usufructuary right.

The sessions of the Third Law of the Sea Conference have ended inconclusively, with no regime settled for the implementation of mining rights to the ocean floor. At present, customary international law provides for the taking of nodules from the high sea beds. While the high seas are common to all nations and cannot be appropriated, the wealth they contain can become the object of proprietorship. International law has developed only hazy concepts of possessory, usufructuary, and exclusive rights with respect to moveable property. Mining rights concepts, which enjoy acceptance in domestic law, were tried on the international level on the island of Spitybergen prior to the treaty of Paris. A similar kind of regime could emerge as a special seabed custom. The United Nations has declared a moratorium on exploitation of the ocean floor beyond the limits of national jurisdiction, pending the establishment of an international regime. The absence of any effective prohibitory rule for this resolution makes a clarification of mining rights of even more importance. (Wilson-Florida)
W80-04467

REMOTE SENSING EVIDENCE AND ENVIRONMENTAL LAW,
Rutgers-The State Univ., Newark, NJ. School of Law.
H. A. Latin, G. W. Tannehill, and R. E. White.
California Law Review, Vol 64, No 6, p 1300-1446, December 1976.

Descriptors: *Remote sensing, *Environmental control, *Monitoring, Legal aspects, Federal water pollution control act, Regulation, Strip mines, Administrative agencies, Water pollution, Reliability, Satellites(Artificial).

Remote sensing is the generic label applied to the technology designed to collect information about the earth's physical properties. The typical remote sensing application employs some form of aerial or satellite reconnaissance to measure and record environmental phenomena from a distance. To date, no accessible judicial or administrative opinion presents a comprehensive analysis of the utility and admissibility of remote sensing information. This information is relevant in the implementation of various natural resources and environmental programs. Two examples are in regard to the enforcement of water pollution controls, and in the control of strip mining. Remote sensory information can be utilized in investigatory and policy planning contexts, to determine conformance with regulatory standards and to document probable cause. In order for remote sensing output to be accepted in courts, the information must comply with formal rules of evidence. The submission strategy probably will parallel that employed for most types of scientific evidence. Thus the information will be in the form of expert testimony, and must pass basic legal tests for reliability. (Wilson-Florida)
W80-04468

A RECIPE FOR BAD WATER: WELFARE ECONOMICS AND NUISANCE LAW MIXED WELL,
Franklin Thomas Backus Law School, Cleveland, OH.
P. D. Junger.
Case Western Reserve Law Review, Vol 27, No 1, p 3-335, Fall 1976.

Descriptors: *Federal water pollution control act, *Economic impact, *Economic justification, Federal government, Legislation, Water pollution control, Legal aspects, Economic impact, Water quality, Ecology, Environmental control.

The 1972 Federal Water Pollution Control Act Amendments represent the first comprehensive modern attempt to achieve an effective scheme for water pollution control at the federal level. Passage of the Amendments and the increasing interest shown in interdisciplinary studies in law and economics suggest that lawyers will be confronted with the argument that implementation of the Amendments will be too costly. Under the doctrine of welfare economics, an optimal economic state can be reached, if the world behaved like an economic model of an efficient market. This theory should not apply to pollution control which is basically a moral question. The claim of excessive cost in cleaning our water cannot be ethically

or practically supported. Traditional nuisance law has been ineffective as a means of reducing water pollution. Nuisance law, both public and private, is a conflicting morass of doctrines which represents efforts to deal with individual situations rather than to provide clarity in defining legal rights. Failure to implement the Amendments will result in excessive water pollution, even if one accepts the premises of welfare economics. (Wilson-Florida)
W80-04469

DON'T LET POLITICS PROSCRIBE CLIMATIC RESEARCH,
Scripps Institution of Oceanography, La Jolla, CA.
W. A. Nierenberg.
Ceres, Vol 11, No 6, p 23-25, November-December, 1978.

Descriptors: *Research priorities, *International waters, *Weather forecasting, Weather data, Weather modification, Conferences, Fisheries, Research and development, International commissions, Climates, Climatic data.

Air-Sea Interaction, a new discipline, is being pursued by many nations worldwide. The ocean's role in climate change is important to understand, as such changes could have serious effects upon fishery resources. The Law of the Sea negotiations, begin in 1973, could have some bad effects in this area. The two major issues of this conference were ownership of fishery resources and mineral wealth. The former was rendered moot when Congress passed the Fisheries Conservation Act, giving United States fisheries control over a 200 mile contiguous zone. The latter issue will be surmounted when unilateral full-scale mining action is undertaken by a national company. The result of the negotiations could be an effort to restrict scientific research. Permission to conduct research must be obtained from the controlling nation and there is no method of appeal or arbitration. The negotiations must take a new direction and attempt to lighten political restraints on research. (Tabano-Florida)
W80-04470

THE PROTECTION OF HYDROLOGIC AND LAND PRESERVATION VALUES UNDER THE SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977: A WELCOME REFORM,
Appalachian Research and Defense Fund, Inc., Charleston, WV.
D. Wooley.
West Virginia Law Review, the National Coal Issue, Vol 81, No 4, p 627-670, 1979.

Descriptors: *Strip mining, *Strip mine wastes, *Surface runoff, *Soil conservation, Water pollution control, Land fills, Public rights, Sediment control, Land use, Government finance, Governmental interrelations, Hydrology.

The 1977 Surface Mining Control and Reclamation Act (Act) is evaluated in the context of West Virginia's 1971 Surface Mining and Reclamation Act. The federal Act is viewed as an improvement over state legislation in the following areas: (1) protection of hydrologic balance; (2) prevention of water contamination; (3) design of sediment ponds and water impoundments; and (4) conservation of topsoil and revegetation. Several land use considerations are also discussed in relation to the federal Act. The public participation aspects of the Act are outlined in a typical scenario. The Act should improve state enforcement mechanisms of strip mining laws, especially through financial assistance to upgrade the state programs. An interim program was put into effect while the state legislation was being upgraded. Problems arising between the state and federal agencies during this interim are briefly discussed. The fate of effective regulation is not good as the state has committed itself to the industry's view of the Act. The state and federal agencies must settle their differences in favor of effective implementation. (Tabano-Florida)
W80-04471

WATER QUALITY COMMITTEE-ANNUAL REVIEW OF SIGNIFICANT LEGISLATURE, JUDICIAL AND ADMINISTRATIVE, ACTIVITIES DURING 1977.
American Bar Association, Washington, DC. Natural Resources Law Section.
Natural Resources Lawyer, Vol 11, No 1, p 234-266, 1978.

Descriptors: *Water quality standards, *Water pollution control, *Administrative agencies, Legislation, Water quality, Federal Government, Judicial decisions, Effluents, Water law, Regulation.

In 1977, the federal courts rendered a large number of decisions interpreting provisions of the Federal Water Pollution Control Act (FWPCA). These cases involved the need for plans for pollution control under Section 208, review of effulent limitations and discharge permits, enforcement of the FWPCH requirements by the federal Environmental Protection Agency (EPA) and the citizens' groups and other issues involving private dischargers. Decisions dealing with the construction and funding of publically-owned treatment works are omitted. Significant EPA proposed regulations under the FWPCA, the Safe Drinking Water Act, and the Maine Protection, Research and Sanctuaries Act. These included National Secondary Drinking Water Regulations and regulations dealing with construction grants, effluent limitations, and toxic pollutant standards. Congress passed lengthy amendments to the FWPCA known as the Clean Water Act. Practically no major provision of FWCPA was left untouched. Changes were made to the construction grants program, Section 208 (water quality management and planning) requirements for industries, the control of toxic water pollutants, and Section 404 (the regulation of the discharge of dredged or fill material) among others. (Wilson-Florida)
W80-04472

DISPUTE SETTLEMENT IN THE LAW OF THE SEA CONVENTION: THE MILITARY ACTIVITIES EXCEPTION,
M. W. Janis.
Ocean Development and International Law Journal, Vol 4, No 1, p 51-65, 1977.

Descriptors: *Law of the sea, *Military aspects, *International law, Negotiations, Conferences, United nations, International commissions, Law enforcement, Legal aspects, Treaties.

The most concrete result of eight years of Law of the Sea negotiations is the Informal Single Negotiating Text. The Text consists of three substantive parts and a fourth part concerning dispute settlement. A party may ratify the Text but not accept some or all of the procedures for dispute settlement in specific categories. Article 18, Section 2(c) contains an exception to dispute settlement procedures concerning military activities, it being understood that law enforcement activities pursuant to the Law of the Sea Convention shall not be considered military activities. Military activities have been one of the maritime interests which the great powers have been particularly diligent in protecting. Although the exception seems to favor naval powers, in practice it would not. The emerging rules of the Law of the Sea are favorable to naval operations. It is more likely that the military activities exception would be used by coastal states resisting superpower naval activities. Thus the exception will remove activities from dispute settlement procedures which are almost certainly in need of peaceful resolution. (Wilson-Florida)
W80-04474

JURISDICTIONAL AND ADMINISTRATIVE LIMITATIONS AFFECTING MANAGEMENT OF THE HALIBUT FISHERY,
International Pacific Halibut Commission, Seattle, WA.
B. E. Skud.
Ocean Development and International Law Journal, Vol 4, No 2, p 121-142, 1977. 1 Tab, 32 Ref.

Descriptors: *United States, *Canada, *Fisheries, *International law, Fish, Fishing, Treaties, International commissions, Fish populations, Legislation, Foreign countries.

The International Pacific Halibut Commission, created by the 1923 Canadian-United States Halibut Convention, has managed the halibut fishery for these two countries for more than 50 years. Under the Convention and its subsequent revisions, the parties agreed among other things, to divide the waters into areas, to establish seasons, to limit catches, and make necessary regulations. The Convention has not been revised since 1953, and there is a question whether the Commission can effectively manage the fishery under existing guidelines. During the past 25 years, significant changes have occurred in the international fishery scene, with the extension of the fishery zone to 12 miles, and the imminent implementation of a 200-mile limit. National goals such as limited entry and optimum yield have not been incorporated in the terms of the existing Convention. These inconsistencies, as well as administrative deficiencies, have limited the effectiveness of the Commission. A revision of the present treaty and associated legislation is recommended. Suggestions are made for the restructuring of international arrangements now under study by the federal governments. A reference list is included. (Wilson-Florida)
W80-04475

THE IDAHO WATER PLAN: TWO THRESHOLD CONSTITUTIONAL PROBLEMS AND SUGGESTED SOLUTIONS,
Idaho Univ., Moscow.
D. L. Grant.
Idaho Law Review, Vol 15, No 3, p 443-507, Summer 1979.

Descriptors: *Idaho, *Water resources development, *Water management(Applied), Water resources, Water permits, Appropriation, Agencies, State governments, Water rights, Governmental interrelations, Constitutional Law.

The recent development of the Idaho water plan is a milestone in an ambitious state water resource development and management program. The development of a state water plan grew out of efforts by other western states and by the Department of the Interior to implement water programs which might direct Idaho's water resources. Two constitutional issues are of major importance in carrying out the Idaho plan. The first is one of intragovernmental relations, namely, the proper roles of the Idaho Legislation and the Idaho Water Resource Board in setting state water policy. The Idaho Constitution gives the Board power to implement a plan under such laws as may be prescribed by the legislature. Litigation has arisen over the extent of the Board's powers. The second issue involves the state's power to prohibit new appropriations which conflict with the objectives of the state water plan. The basic question is whether the disapproval of new appropriations on the ground of conflict with the public interest is contrary to the Idaho Constitution, which assures the right to appropriate waters. (Wilson-Florida).
W80-04476

NO WATER FOR THE WOODS: A CRITICAL ANALYSIS OF UNITED STATES V. NEW MEXICO,
California Univ., Berkley.
S. K. Fairfax, and A. D. Tarlock.
Idaho Law Review, Vol 15, No 3, p 509-554, Summer 1979.

Descriptors: *Forest management, *Federal-state water rights conflicts, *Water allocation(Policy), Water resources, Legal aspects, Land management, Federal reservations, Reclamation legislation, Judicial decisions.

United States v. New Mexico, decided in 1978, is the first Supreme Court opinion to confront directly the following questions: When may a federal land management agency assert the implied intent of Congress to reserve appurtenant water rights, when public land is withdrawn from entry. The majority of the Supreme Court decided that the Forest Service could not claim reserved rights for

the preservation of instream flows, recreation, and stockwatering. At issue was the implied intent of Congress in passing the 1891 Creative Act and the 1897 Organic Administration Act. An alternative reading of the two acts and other relevant legislation suggests that the 1891 Act authorizing forest reservations was intended to preserve the forests, and that the 1897 Act did not significantly alter the 1891 legislation. From this legislative interpretation, the Court's construction of the two acts is arguably wrong because the reservation of water for instream uses is consistent with the original reserve purposes. The decision also creates future federal-state water conflicts arising out of reserved right claims by federal land managers. (Wilson-Florida)
W80-04477

AN EQUITABLE REGIME FOR SEABED AND OCEAN SUBSOIL RESOURCES,
New York Univ., NY. Center for International Studies.
T. M. Franck, T. M. Kennedy, and C. V. Trinko.
Denver Journal of International Law and Policy, Vol 4, No 2, p 161-186, Fall 1974.

Descriptors: *Law of the sea, *International law, *Resources development, Oceans, United Nations, Treaties, Natural resources, Subsoil, International waters, Jurisdiction, Mining.

Ocean mineral resources are the world's last great new frontier in an era of massive mineral consumption and predictable mineral shortages. A strategy is needed for the implementation of an equitable regime for the allocation of the seabed and the ocean subsoil. The United Nations Seabed Committee has begun work drafting a treaty establishing an international regime for the exploitation of the seabed. This effort has been closely linked to the problem of defining the area subject to national jurisdiction. An equitable principle applicable to the seabed and subsoil can be formulated as follows: No state should be permitted to extend its jurisdiction over seabed and subsoil resources without sharing the benefits with the rest of the international community in accordance with each member's need. Revenue sharing, rather than a division of jurisdiction and multiplicity of operating authorities, has the advantage of simplicity and acceptability to coastal states. Advantages of an equitable sea regime include: (1) avoiding the potential conflict of a race for ocean space; (2) making international aid a multilateral undertaking; (3) establishing an international administration to protect the freedom of the high seas beyond national jurisdiction. (Wilson-Florida)
W80-04478

INTERNATIONAL RAMIFICATIONS OF THE FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976,
D. R. Christie.
Georgia Journal of International and Comparative Law, Vol 7, No 1, p 133-147, 1977.

Descriptors: *Law of the sea, *International law, *Marine fisheries, Fisheries, Conservation, Legislation, Foreign countries, International waters, United nations, Water law, Marine fish.

On April 13, 1976, President Ford signed the Fishery Conservation and Management Act (Act). This Act established a 200 mile fishery conservation zone over which the United States (U.S.) will exercise exclusive fishery management. The U.S. became the first major power to declare unilaterally a 200 mile exclusive fisheries zone. Many experts expressed doubts as to the legality of these exclusive zones under international law. Other issues to be faced by the U.S. in the implementation of the Act include: (1) prior treaty obligations and negotiations; (2) stress on relations with the Soviet Union, Japan and Latin America; (3) a rash of unilaterally declared zones which exceed the Fisheries Act; and (4) enforceability. The adoption of a 200 mile exclusive zone by the United States made unilateral extension an acceptable concept. The result has been a virtual 'sea-grab' by coastal nations. The successful extension of these zones may lessen the incentive to reach agreement at the Law of the Sea Conference. (Wilson-Florida)
W80-04479

TOWARD THE MAXIMIZATION OF A RESOURCE: THE 1971 WASHINGTON WATER RESOURCES ACT,
S. R. Pruzan.
Gonzaga Law Review, Vol 9, No 3, p 759-779, Spring 1974.

Descriptors: *Washington, *Water resources, *Water allocation(Policy), Base flow, Legislation, Hydrology, Water law, Administrative agencies, Riparian rights, Economics, Water conservation.

The 1971 Washington legislature enacted the Water Resources Act (Act). Under this legislation, the Washington State Department of Ecology must promulgate regulations to preserve and use water in a manner which will promote the 'public health and economic well being of the state and the preservation of its natural resources and aesthetic values.' The Act does not supersede the 1917 Water Code or other established legislation. The Act was needed because the improper use of water resources in Washington has led to a multitude of problems. To a great extent, pre-Act law, the lack of adequate hydrologic data, and the absence of sound economic theory are responsible for this inefficient use. Maximization of benefits under the Act will be established by base flow requirements, with ample consideration of recreation, fish and wildlife. Washington's allocation system will also be revamped. Maximum net benefits mean increased water transferability and the promulgation of regulations to protect purchases and encourage sales. (Wilson-Florida)
W80-04480

TRANS-BOUNDARY POLLUTION INJURIES: JURISDICTIONAL CONSIDERATIONS IN PRIVATE LITIGATION BETWEEN CANADA AND THE UNITED STATES,
S. C. McCaffrey.
California Western International Law Journal, Vol 3, No 2, p 191-259, May 1973.

Descriptors: *Water pollution effects, *Remedies, *Canada, *United States, Treaties, Legal aspects, Pollutants, International Joint Commission, Jurisdiction, International law, Boundaries(Surfaces).

Burgeoning industrialization in the past half-century has increased the probability that nations will injure each other through the medium of shared natural resources. Treating every private injury by trans-boundary pollution as an international tort will do little to further the cause of harmony among nations. The importance of dealing with pollution problems regionally is well recognized, by tailoring specific preventive, regulatory or remedial measures to the air or watersheds concerned. Most natural resource problems arising along the Canadian-American boundary have been dealt with under the 1909 Boundary Waters Treaty or through the International Joint Commission which the Treaty created. Although air and water pollution problems have recently received much attention, the 1909 Treaty primarily focuses on navigation and diversion of waters. The Treaty does create private rights for extraterritorial injuries caused by diversion of water, but does not explicity address remedies for pollution injuries. The principal problem for plaintiffs suing under common law actions for injuries has been jurisdictional. The plaintiff must either sue in the defendant's country or encounter problems getting the defendent into court in the plaintiff's country. (Wilson-Florida)
W80-04481

COASTAL ZONE MANAGEMENT AND EXCLUDED FEDERAL LANDS: THE VIABILITY OF CONTINUED FEDERALISM IN THE MANAGEMENT OF FEDERAL COASTLANDS,
National Oceanic and Atmospheric Administration, Washington, DC.
M. E. Shapiro.
Ecology Law Quarterly, Vol 7, No 4, p 1011-1043, 1979.

Descriptors: *Federal-State Water Rights Conflicts, *Coasts, *Resources development, Legislation, State jurisdiction, Federal jurisdiction, Management, Water law, Administrative agencies, Water resources.

The 1979 Coastal Zone Management Act (CZMA) as amended authorizes a national program for the management, beneficial use, protection, and development of the natural resources in the nation's coastal zone. One goal of the Act is to encourage coastal states to exercise their full authority over the coastal zone resources. In defining coastal zone, Congress included a significant and controversial exception. Section 304(1) of the CZMA excludes from coastal zones those lands the use of which is subject to the discretion of or which is held in trust by the Federal Government. Many coastal states have argued that their ability to plan for and adequately manage their coastal resources has been seriously hampered by this exclusion of federal coastlands. However, under the federal consistency provisions of the CMZA, a state may influence management of federal coastlands to the extent federal land activities affect resources within the state's coastal zone. Federal agencies and the courts have differed over the interpretation of the relevant provisions of the Act. To ensure a viable, continuing federalism in the management of federal coastlines, the states must exercize their full range of powers in a manner that will both serve state goals and recognize the unique national interests associated with federal coastlines. (Wilson-Florida)
W80-04482

RECLAMATION LAW CONSTRAINTS ON ENERGY/INDUSTRIAL USES OF WESTERN WATER,
Environmental Defense Fund, Denver, CO.
G. W. Pring, and L. Edelman.
Natural Resources Lawyer, Vol 8, No 2, p 297-306, 1975.

Descriptors: *Reclamation, *Agricultural watersheds, *Water allocation(Policy), Energy, Agriculture, Industrial water, Water resources, Water policy, Administration, Resevoirs, Water demand.

The massive energy resources of the Western states have great potential for development. The various methods of energy conversion and transportation of energy resources will require enormous quantities of water - one of the region's scarcest resources. Even where available, water supply may quickly be exceeded by demand, creating conflicts between water needs for energy and for other uses, particularly agriculture. With increasing frequency, federal water storage projects are undergoing a changeover from agriculture to energy/industrial supply. As early as 1967, the Bureau of Reclamation began contracting to deliver large quantities of water to energy industries. However, there are legal constraints on western water use for energy. These limitations arise first under the federal reclamation laws. Bureau of Reclamation's authority to provide industrial water must be found both in the organic reclamation laws and within specific enabling legislation for the project from which the industrial water would be supplied. The apparent conflicts of existing law contain potential for legal challenge. These issues must be resolved before further contracting or delivering. The courts and the Congress should take the lead in this endeavor. (Wilson-Florida)
W80-04483

WATER QUALITY COMMITTEE (ANNUAL REVIEW OF ACTIVITIES - 1975).
American Bar Association, Washington, DC. Natural Resources Law Section.
Natural Resources Lawyer, Vol 9, No 2, p 311-318, 1976.

Descriptors: *Potable water, *Water quality standards, *Waste water(Pollution), Legislation, Public health, Water law, Water quality control, Judicial decisions, Effluents, Radioactive wastes.

In December, 1974, Congress passed the Safe Drinking Water Act (Act). Under this Act, the

federal Environmental Protection Agency (EPA) is directed to establish primary and secondary drinking water standards. The Act is applicable to public water systems, defined as a system for providing piped water with at least 15 service connections or for at least 25 individuals. Regulations are provided for state underground injection control programs which are of most concern to the oil and gas industry. The states are the primary enforcers of the Act. If the state has not developed an enforcement plan satisfactory to the administrator of the EPA, the administrator may take action. In 1975, approximately 400 court cases were filed concerning the interpretation of the Act's provisions. The issues dealt with by the more significant decisions included: (1) effluent limitations; (2) thermal discharge variances; (3) toxic substances and pre-treatment standards; (4) the NPDES permit program; (5) dredge and fill permit program; (6) areawide waste management planning; (7) regulation of radioactive waste discharges; and (8) construction grants program. (Wilson-Florida)
W80-04484

NOAA'S MARINE SANCTUARY PROGRAM,
National Oceanic and Atmospheric Administration, Rockville, MD. Coastal Zone Management Office.
R. R. Kifer.
Coastal Zone Management Journal, Vol 2, No 2, p 177-188, 1975.

Descriptors: *Wildlife management, *Federal project policy, *Preservation, Coasts, Legislation, Protection, Water law, Marine animals, Federal jurisdiction, Oceans, Environmental effects.

Authority to designate marine sanctuaries was established by Title III of the 1972 Marine Protection, Research, and Sanctuaries Act (Act), as the ocean water counterpart to our National Parks and Seashores. Responsibility for implementing the marine sanctuary program was delegated to the Office of Coastal Zone Management (OCZM) of the National Oceanic and Atmospheric Administration. A sanctuary may have a designation in any of the following areas: (1) habitats; (2) species; (3) recreational and aesthetic; (4) research; and (5) unique. A nomination for marine sanctuary designation may come from any individual, organization, or governmental body. A nomination is processed by the OCZM with public participation. The Act requires consultation with both state and federal agencies. An environmental impact statement is also required. The process culminates in sanctuary designation. The day-to-day operations of the sanctuary are covered in part by the Act, including both surviellance and protection. The Act provides for prosecution of violators. (Wilson-Florida)
W80-04485

THE WINTERS DOCTRINE ON RESERVED WATER RIGHTS IN IDAHO: AVONDALE IRRIGATION DISTRICT V. NORTH IDAHO PROPERTIES, INC.,
B. Palmer.
Idaho Law Review, Vol 15, No 3, p 591-603, Summer 1979.

Descriptors: *Idaho, *Reservation doctrine, *National forests, *Federal-state water rights conflicts, Federal reservations, Wildlife conservation, Fish conservation, Legislation, Natural resources, Indian reservations, Water allocation(Policy).

This note concerns two recent cases which addressed questions relating to federal reserved water rights on national forest land in Idaho. At issue was whether Idaho law required the federal government to specifically quantify its water needs for national forest purposes, and if so, whether reservation of the entire natural flow of streams in national forests was specific enough quantification to satisfy that requirement. Both cases involved the application of the Winters Doctrine. Under this doctrine, whenever the federal government reserves land from the public domain, it also impliedly reserves rights to water not previously appropriated which is necessary for the fulfillment of its purpose of the reservation. The Idaho Supreme Court concluded that the reservation of water for forests in each case was specifically reserved for the limited purposes of 'preserving a perpetual supply of timber and protecting watersheds to secure favorable conditions of water flows.' Fish and wildlife preservation, recreation, and aesthetics were found not to be proper purposes for reserving water for national forest land. Federal water rights under the specific quantification statute must fall within the limited defined purposes. (Schwerer-Florida)
W80-04486

IMPACT OF THE 1977 CLEAN WATER ACT AMENDMENTS ON INDUSTRIAL DISCHARGERS,
Morgan, Lewis and Bockius, Washington, DC.
J. Quarles.
Environmental Reporter, Vol 8, No 46, Monograph No 25, March 17, 1978. 12 p.

Descriptors: *Waste water treatment, *Water quality standards, *Federal Water Pollution Control Act, *Industrial plants, Waste water, Pollutants, Discharge(Water), Water pollution control, Legislation, Water pollution sources, Regulation, Administrative agencies.

The 1977 Clean Water Act (1977 Act) comprehensively amended the 1972 Federal Water Pollution Control Act. Under the 1977 Act companies not in compliance with the 1977 requirements may obtain a limited extension of the compliance deadline. The 1977 Act substantially revises the standards for best available technology control, previously scheduled for completion by 1983. Variances from the requirements for control of nonconventional pollutants are permitted under specified conditions. The regulatory framework is expanded by authorizing the federal Environmental Protection Agency to issue regulations to control and restrict the runoff of toxic and hazardous materials. Provisions for noncompliance fees were not included in the legislation as finally enacted. The pretreatment requirements are modified to provide discharges credit for any removal of toxic pollutants by a municipal sewage treatment plant. As a consequence of this prospect, companies may wish to reconsider the advantages of tieing into a municipal system. (Wilson-Florida)
W80-04487

DEMORALIZED WETLANDS OWNERS: IS THERE JUST COMPENSATION AFTER BRECCIAROLI V. CONNECTICUT COMMISSIONER OF ENVIRONMENTAL PROTECTION.,
R. W. Reeves.
Connecticut Bar Journal, Vol 53, No 1, p 60-72, February 1979.

Descriptors: *Wetlands, *Connecticut, *Legislation, *Land use, Judicial decisions, Regulation, Environmental control, State governments, Water law, Tidal marshes, Administrative agencies.

In 1971, the Connecticut Commissioner of Environmental Protection designated as tidal wetlands property owned by Dante Brecciaroli. The statutory authority for the action was the Tidal Wetlands Act. This is one of two Connecticut statutes dealing with the preservation of wetlands, the other is the Inland Wetlands Act. Under either act an owner of property designated as wetlands can conduct no 'regulated activity' on the property without a permit. This term essentially encompasses all those uses which an average landowner might want to conduct on his land. Mr. Brecciaroli applied to the Commissioner for a permit to fill-in 5.3 acres of the wetland area. Following a hearing, this application was denied, this judgment being affirmed by the Connecticut Supreme Court. The Brecciaroli decision exemplifies a weakness in the wetlands regulatory scheme: an ever-increasing procedural burden is placed upon owners of wetlands who desire to conduct some reasonable use on their properties. The decision also raises the question of when and how a landowner ought to be compensated for the effects of land-use regulation. (Wilson-Florida)
W80-04488

OIL SPILLS - STATE PREVENTION AND THE POSSIBILITY OF PRE-EMPTION,
S. R. Armstrong.
Mercer Law Review, Vol 30, No 2, p 559-572, Winter 1979.

Descriptors: *Washington, *Oil spills, *Water pollution control, Federal government, Environment, Environment controls, Legislation, Shore protection, Coasts, Oil, Transportation.

The likelihood of oil spills and related accidents has caused concern to coastal states. A state legislature's problems in seeking to balance energy demands with environmental concerns are complicated by federal environmental regulation. Confronting these conflicting interests the Washington State Legislature passed the 1975 Washington Tanker Law (Act). A case challenging the constitutionality of that law, Ray v. Atlantic Richfield Co. (Ray) is analyzed. The development of the doctrine of federal pre-emption is discussed. The use of the doctrine of federal pre-emption in the Ray case is examined. The court's ruling invalidated certain provisions of the Act - the pilot licensing and the safety and design features among others, but upheld other provisions. There is a discussion of alternative methods of balancing the need for energy against the potential hazards of oil transportation. Among the alternatives discussed are state acts which protect the environment by providing for damages after-the-fact. This would protect a state's environment while avoiding the chances of federal pre-emption. (Daniels-Florida)
W80-04489

THE IRRIGATION REVOLUTION AND ITS ENVIRONMENTAL CONSEQUENCES,
J. Aucoin.
Environment, Vol 21, No 8, p 17-20, 38-40, October 1979.

Descriptors: *Nebraska, *Irrigation systems, *Erosion, *Groundwater recharge, Water table, Water quality, Water pollution, Environmental effects, Groundwater, Groundwater availability, Water resources, Irrigation.

The center pivot irrigation system is examined as to its good features and the environmental consequences for its use. The effect of this system in Nebraska is emphasized. The advantages over other systems are briefly discussed. About a third of the irrigated acres in Nebraska are serviced by center pivot systems and this percentage is growing. The problems associated with this increase in acreage serviced by this system are analyzed. These include land erosion and a vanishing water table. Actions taken to combat these growing problems are discussed. Related to the water quantity questions are the problems of water quality. Pollution of groundwater associated with use and reuse of the same water is explored. Conflict of interests between local communities benefited by the increase in center pivot irrigation system's use and state officials and environmentalists are discussed. Whether Nebraska and other plains states can avoid destruction of their necessary resources is still unresolved. (Daniels-Florida)
W80-04490

PRESCRIPTIVE ADMINISTRATIVE PROPOSAL: AN INTERNATIONAL MACHINERY FOR CONTROL OF THE HIGH SEAS,
Virginia Univ., Charlottesville. Inst. of Government.
N. D. Joyner, and C. C. Joyner.
International Lawyer (A.B.A.), Vol 8, No 1, p 57-73, January 1974.

Descriptors: *Inter-agency cooperation, *International law, *Fisheries, Administration, Administrative agencies, United Nations, Coordination, International waters, Fishing, Oceans, Administrative decisions.

An administrative model for international control of the high seas is proposed. Increasing reliance on resources from the sea, especially fish, present reasons for encouraging international cooperation in regulating fisheries on the high seas. The history of

international administrative control over this area is examined. There is a brief summary of the ocean-related functions of seven major United Nations agencies (U.N.) whose organizational goals include a concern for research and development of the ocean environment on an international level. An analysis of the hierarchy of United Nation's functional agencies is included. Prescriptive proposals for the reorganization of the U.N. marine-oriented agencies are presented, with an explanation of the proposed hierarchy for international high seas control. Methods to expedite international control of the high seas are briefly discussed. To be successful, the proposed administrative machinery for control of the high seas requires: (1) rational analysis of the framework of existing U.N. marine-oriented agencies; and (2) a realization of the realities of international power politics combined with existing modes of coping with marine environmental problems. (Daniels-Florida)
W80-04491

MODEL COASTAL ZONE STATUTE,
N. Smith, P. Ratner, and A. MacBeth.
Coastal Zone Management Journal, Vol 1, No 2, p 209-225, Winter 1974.

Descriptors: *Zoning, *Coasts, *Shore protection, *Model studies, Resources development, Permits, Programs, Planning, Legal aspects, State governments, Natural resources, Conservation.

This model coastal zone management statute provides a possible state response to the federal 1972 Coastal Zone Management Act. The statute is designed to provide a general plan conforming to specific requirements of the federal Act which may be adapted to specific requirements of individual states. The model statute was written with the intention that all or parts of it could be adapted to the wide variety of state regulatory schemes with the aim of providing unitary management. A Coastal Zone Commission is created with a two-part jurisdiction consisting of the shore area and the larger coastal zone. The Commission will plan, regulate and assume certain functions of existing state agencies, with final responsibility for authorizing development within the coastal zone. Centralized control is a major promise of the statute. The Commission must prepare a coastal zone plan, which will serve as a basis for zoning and permit regulation. Once the plan is in effect, a permanent system of regulation reflecting a different balance of interests for the shore area and the larger coastal zone will be established. (Daniels-Florida)
W80-04492

SOCIAL EQUITY IN COASTAL ZONE PLANNING,
California Univ., Berkley.
T. Dickert, and J. Sorensen.
Coastal Zone Management Journal, Vol 1, No 2, p 141-150, Winter 1974. 1 Tab.

Descriptors: *Coasts, *Zoning, *Decision making, *Social impact, Equity, Social values, Resources, Standards, Resource allocation, Resource development, Land use.

A list is presented of social-economic impacts that coastal zone decision-makers should consider, either when developing coastal policies or when reviewing proposed projects in the coastal zone. A checklist is developed to relate the socio-economic impacts identified to information and methods necessary for impact assessment. The present emphasis of coastal planning on environmental protection and economic development fails to give broader consideration to social equity and social values. This inadequate consideration of social values means many policies developed for environmental protection or economic development of coastal resources may be socially regressive. The objectives of most coastal planning programs are listed. Problems are outlined which will be encountered in the attempt to include social equity considerations in coastal planning. A process is offered which can provide for the consideration of social impacts in a coastal planning program and resolve some of the problems outlined. (Daniels-Florida)
W80-04493

COASTAL STATES ORGANIZATION: THE PAST AND FUTURE,
Coastal States Organization, Charleston, SC.
J. A. Timmerman, Jr.
Coastal Zone Management Journal, Vol 1, No 1, p 119-122, Fall 1973.

Descriptors: *State governments, *Shore protection, *Coasts, Federal government, Resources development, Conferences, Organization, Oceanography, Legislation, Research and development.

A major recommendation of the Stratton Commission to the President in 1968 called for the federal government and the coastal states to collectively create a mechanism to better manage their coastal resources. In November 1968, the first conference ever held among the maritime states was convened in Miami by the Governor of Florida and the Florida Commission on Marine Sciences and Technology. Another meeting was held by representatives of 22 coastal states in Savannah, Georgia in 1970. At this meeting provisional articles of organization were drawn up and a resolution was passed recommending the articles be submitted to the respective states for adoption. The Coastal States Organization (CSO) is open to those states or commonwealths having an ocean, gulf, or Great Lakes Boundary. Among its responsibilities, the CSO contributes to the development of common policy regarding national coastal management legislation and programs. Its major accomplishment to date has been aiding the passage of the 1972 Federal Coastal Zone Management Act. CSO's primary aim for the future should be to focus attention on the National Coastal Zone Management Program and Coastal Zone Research and Technical Services Program. (Wilson-Florida)
W80-04494

ENVIRONMENTAL PROTECTION MOTIVATION IN COASTAL ZONE LAND-USE LEGISLATION,
Conservation Foundation, Washington, DC.
S. Zwicky, and J. Clark.
Coastal Zone Management Journal, Vol 1, No 1, p 103-108, Fall 1973.

Descriptors: *Shore protection, *Land use, *Coasts, *Land development, Flood plains, Wetlands, Legislation, Environmental control, Land management, State governments, Ecosystems, Coastal plains.

The coastal environment is particularly sensitive to the adverse impacts of development. Recognizing that traditional land controls do not provide the needed coastal zone protection, many states have enacted special land-use legislation aimed in part at preserving natural values in coastal areas. Seventeen of the 30 coastal states have substantive coastal zone land protection laws. The four purposes cited most frequently among laws of these 17 states were: (1) protection of wildlife and fisheries; (2) protection of ecosystems or the natural environment; (3) control of development; and (4) enhancement of aesthetic values. Other purposes included: protection of life and property, enhancement of public recreation, soil conservation, and protection of water resources. Development and economic purposes were cited in relatively few laws. The 1972 Coastal Zone Management Act establishes federal policy, authorizes federal assistance to states for developing programs of coastal zone land use control and provides for state approval of federal projects in the coastal zone. (Wilson-Florida)
W80-04495

THE EMERGENCY POWERS IN THE ENVIRONMENTAL PROTECTION STATUTES: A SUGGESTION FOR A UNIFIED EMERGENCY PROVISION,
R. B. Skaff.
The Harvard Environmental Law Review, Vol 3, p 298-325, 1979.

Descriptors: *Pollution abatement, *Environmental control, *Federal Water Pollution Control Act, Protection, Governmental interrelations, Government finance, Administrative agencies, Administrative decisions, Judicial decisions, Remedies.

The emergency powers of the Clean Water Act, the Safe Drinking Water Act, the Clean Air Act, and the 1976 Resource Conservation and Recovery Act are evaluated. A short history of these powers is presented, emphasizing two periods of legislation. The first was characterized by civil remedy provisions. The second by other emergency enforcement options. This is followed by a brief overview of the discretionary powers. Several major themes of the various acts are presented and analyzed: (1) the varying scope of protection; (2) interaction with state and local authorities; (3) the 'imminent and substantial endangerment' standard, including a lengthy discussion of civil actions and the meaning and application of the standard; (4) other remedies; (5) administrative orders; and (6) the funded emergency assistance program. The emergency powers are an effective bargaining tool for obtaining action from state and local governments and individual polluters. It is suggested that the separate provisions be unified under a single provision to reduce the administrative and judicial burden of interpretation and to provide a more efficient legal authority. (Tabano-Florida)
W80-04496

THE FUTURE OF SCIENTIFIC RESEARCH IN CONTIGUOUS RESOURCE ZONES: LEGAL ASPECTS,
J. R. Moore.
International Lawyer (A.B.A.), Vol 8, No 2, p 242-261, April 1974.

Descriptors: *International law, *Research and development, *Oceans, Legal aspects, Treaties, Resources, International waters, United Nations, Conferences, Coasts, Regime.

Scientific research in contiguous resource zones has been a growing practice of nations, to claim jurisdiction over ocean resources within 200 miles of their coasts. Coastal states claim exclusive or preferential resource jurisdiction. The legal status of scientific research in these zones is unsettled. The historical practices of states' scientific research in the oceans are briefly examined. The current state of the law with regard to scientific research in contiguous zones is explored. Four basic problems in defining the legality of research near coastal waters are examined. In assessing the future of scientific research in contiguous zones, the political climate out of which agreements controling such research must come is discussed. The new international law on scientific research should be in the form of a separate and distinct convention on Marine Scientific Research. Considerations, which the convention drafters should consider are outlined. Suggested are a basic structure for the convention and two provisions of the convention, one dealing with notice, and another regarding participation by coastal states. (Daniels-Florida)
W80-04497

AN INTERNATIONAL COMPARISON OF TRENDS IN WATER RESOURCES MANAGEMENT,
Fordham Univ., Bronx, NY. School of Law.
L. A. Teclaff.
Ecology Law Quarterly, Vol 7, No 4, p 881-915, 1979.

Descriptors: *Comparative benefits, *Water resources development, *Preferences(Water rights), Management, Legal aspects, Reclaimed water, Conjunctive use, Economic efficiency, Water supply, Waste water treatment, Use rates.

Efficient water use has become a major goal of modern water management. The various administrative policies used by legal regimes internationally to encourage conservation, recovery, and reuse of water are evaluated. Developing a comprehensive and consolidated administrative system of water law is the current goal of most water codes. Modern water legislation not only subjects all water to a single regulatory structure, but also includes all uses, whether old or new, under that system. In conjunction with the current trend in water resources management, such concepts as pre-existing uses, preference of use, qualified water rights, pricing systems, recycled water, and con-

junctive use are compared. As worldwide demand for water steadily grows, it is increasingly important that the legal rules governing the management and utilization of water resources actively promote, rather than impede, efficiency in water use. This basic policy goal is evaluated and examined. Possible methods of implementation are suggested. (Schwerer-Florida)
W80-04498

FEDERAL COMMON LAW: JUDICIALLY ESTABLISHED EFFLUENT STANDARDS AS A REMEDY IN FEDERAL NUISANCE ACTIONS,
D. Leybold.
Boston College Environmental Affairs Law Review, Vol 7, No 2, p 293-315, 1978.

Descriptors: *Wisconsin, *Illinois, *Water quality standards, *Water pollution control, Sewage disposal, Federal government, Federal jurisdiction, Judicial decisions, State governments, Water pollution, Legal aspects.

The United States Supreme Court, in Illinois v. City of Milwaukee, revitalized the federal common law of nuisance by ruling that certain suits, alleging that water pollution created a public nuisance, could be heard in federal courts on the basis of federal law. The United States District Court for the Northern District of Illinois, which subsequently heard the case on its merits, made its rulings under the federal common law of nuisance. The district court found that Milwaukee's sewage discharge into Lake Michigan created a nuisance, and ordered Milwaukee to comply with specific court-established effluent standards. The Supreme Court's decision formally added nuisance law, as applied to interstate navigable waters, to the list of substantive areas governed by federal common law. The district court's ruling is consistent with federal common law principles; if the court's standards are seen as findings of fact aimed only at limiting the activities which created the nuisance. Such a holding protects Illinois' sovereign right not to be subjected to outside nuisance. (Wilson-Florida)
W80-04499

NONPOINT POLLUTION CONTROL IN VIRGINIA,
J. V. Cogbill, III.
University of Richmond Law Review, Vol 13, No 3, p 539-556, Spring 1979.

Descriptors: *Virginia, *Urban runoff, *Agricultural runoff, *Water pollution control, Pollutants, Legislation, Soil erosion, Waste, Identification, Federal Water Pollution Control Act, Pesticides, Water pollution sources, Water law.

Nonpoint pollution includes soil erosion from agricultural, silvicultural, and mining sources, as well as urban runoff. Soil erosion is the major pollution threat, carrying the pesticides, fungicides, rodenticides, nutrients placed in the soil, and other contaminants used or created by land use. In Virginia, nonpoint pollution is presently uncontrolled and a threat to the marine environment. In 1972 Congress enacted the Federal Water Pollution Control Act. The discharge control mechanism was articulated in section 402 as the National Pollution Discharge System, establishing a permit program to impose effluent limitations. The states were primarily responsible for implementation. The 1977 Clean Water Act (1977 Act) presented a stronger and clearer direction for states to identify and control sources of nonpoint pollution. Section 208 of the 1977 Act provides that each state develop areawide planning to control such pollution sources as agriculture, silviculture, mining and urban runoff. In Virginia, the State Water Control Board began implementation of a state waste management plan. Virginia relies on voluntary participation by agricultural nonpoint source polluters. A more affirmative role by the state is needed. (Wilson-Florida)
W80-04500

6F. Nonstructural Alternatives

ENVIRONMENTAL PROTECTION MOTIVATION IN COASTAL ZONE LAND-USE LEGISLATION,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04495

6G. Ecologic Impact Of Water Development

ENVIRONMENTAL MANAGEMENT OF MULTIPURPOSE RESERVOIRS SUBJECT TO FLUCTUATING FLOOD POOLS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
T. A. Austin, R. Q. Landers, and M. D. Dougal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-164205, Price codes: A10 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University Technical Completion Report No ISWRRI-84, ISU-ERI-AMES 79238, June 1979. 210 p, 52 Fig, 29 Tab, 27 Ref, 1 Append. OWRT B-049-IA (4).

Descriptors: *Reservoir operation, *Flood control, *Mathematical models, *Shore protection, Iowa, Vegetation effects, Erosion control, Soil conservation, Flood damage, Reservoir releases, Succession, Trees, Forest management, Vegetation regrowth.

Mathematical models were developed and used to simulate the effect of fluctuating water levels in multipurpose reservoirs in Iowa. The models are designed as management and operational tools to evaluate trade-offs between the environmental impacts in the flood pool upstream of the dam and the economic benefits downstream of the dam. The Saylorville Reservoir located on the Des Moines River was used for the study because it periodically inundates an environmentally sensitive and scenic area in the Ledges State Park, one of the area's most popular recreational parks. A dynamic programming optimization model was developed to select the optimal operating policy for the reservoir. The model is forward looking and has only a single decision variable, the release rate from the reservoir. State incremental or discrete differential solution algorithms are not needed as the number of discrete states used is not excessive. The 10 largest historical floods were input to determine the operating policy which best minimizes damages. Also used were a reservoir routing model and a vegetative succession model. The vegetative model simulated general vegetative responses to flooding but it does not give precise results for specific sites. The lower areas of Ledges State Park will be heavily impacted by high reservoir water levels and extensive cleanup will be needed after each inundation. Five vegetative zones were defined for degree of damage and various techniques for mitigation are recommended. (Seigler-IPA)
W80-04204

HIERARCHICAL-MULTIOBJECTIVE APPROACH IN THE PLANNING AND MANAGEMENT OF WATER AND RELATED LAND RESOURCES,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Department.
For primary bibliographic entry see Field 5G.
W80-04291

NOAA'S MARINE SANCTUARY PROGRAM,
National Oceanic and Atmospheric Administration, Rockville, MD. Coastal Zone Management Office.
For primary bibliographic entry see Field 6E.
W80-04485

DEMORALIZED WETLANDS OWNERS: IS THERE JUST COMPENSATION AFTER BRECIAROLI V. CONNECTICUT COMMISSIONER OF ENVIRONMENTAL PROTECTION.,
For primary bibliographic entry see Field 6E.
W80-04488

THE IRRIGATION REVOLUTION AND ITS ENVIRONMENTAL CONSEQUENCES,
For primary bibliographic entry see Field 6E.
W80-04490

ENVIRONMENTAL PROTECTION MOTIVATION IN COASTAL ZONE LAND-USE LEGISLATION,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 6E.
W80-04495

7. RESOURCES DATA

7A. Network Design

A PROPOSED GROUND WATER QUALITY MONITORING NETWORK FOR IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
R. L. Whitehead, and D. J. Parliman.
Geological Survey open-file report 79-1477 (WRI), October 1979. 67 p, 10 Fig, 22 Tab, 25 Ref.

Descriptors: *Groundwater, *Water quality, *Monitoring, *Observation wells, *Network design, Idaho, Hydrologic data, Aquifers, River basins, Model studies, Groundwater movement, Groundwater recharge, Base flow, Water pollution sources, Sampling, Sites, Water analysis, Planning, Evaluation, Data collections, Data storage and retrieval, *Watstore.

A ground water quality monitoring network is proposed for Idaho. The network comprises 565 sites, 8 of which will require construction of new wells. Frequencies of sampling at the different sites are assigned at quarterly, semiannual, annual, and 5 years. Selected characteristics of the water will be monitored by both laboratory- and field-analysis methods. The network is designed to: (1) Enable water managers to keep abreast of the general quality of the State's ground water, and (2) serve as a warning system for undesirable changes in ground-water quality. Data were compiled for hydrogeologic conditions, ground-water quality, cultural elements, and pollution sources. A 'hydrologic unit priority index' is used to rank 84 hydrologic units (river basins or segments of river basins) of the State for monitoring according to pollution potential. Emphasis for selection of monitoring sites is placed on the 15 highest ranked units. The potential for pollution is greatest in areas of privately owned agricultural land. Other areas of pollution potential are residential development, mining and related processes, and hazardous waste disposal. Data are given for laboratory and field analyses, number of site visits, manpower, subsistence, and mileage, from which costs for implementing the network can be estimated. Suggestions are made for data storage and retrieval and for reporting changes in water quality. (Kosco-USGS)
W80-04374

7B. Data Acquisition

AUTOMATIC MEASUREMENT OF SOIL-WATER PRESSURE USING A CAPACITANCE MANOMETER,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
J. L. Thony, and G. Vachaud.
Journal of Hydrology, Vol 46, No 1/2, p 189-196, March 1980. 5 Fig, 4 Ref.

Descriptors: *Soil water, *Pore pressure, *Measurement, *Instrumentation, *Capacitors, *Pressure measuring instruments, Manometers, Soil profiles, Infiltration, Calibrations, Electrical equipment, Patents, Capacitance manometers, Pressure transducers.

A new, cheap, and reliable pressure transducer has been developed. It is based on the use of a mercury manometer with the outer face of the glass tubing covered with a transparent metallic oxide. This acts as the fixed outer electrode of a capacitor, of which the capacitance linearly changes with the position of the mercury in the tube. This pressure transducer can be linked with an automatic recording device. Examples were given of the field use of a series of these transducers in which they were coupled to tensiometers in a natural water-balance study. (Visocky-ISWS)
W80-04305

A NEW TECHNIQUE FOR MEASURING TIDAL CURRENTS BY USING A TWO-SITE HF DOPPLER RADAR SYSTEM,
National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
A. S. Frisch, and B. L. Weber.
Journal of Geophysical Research, Vol 85, No C1, p 485-493, January 20, 1980. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Currents(Water), *Tidal waters, *Tidal effects, *Radar, *Alaska, Remote sensing, Tides, Circulation, Water circulation, Ocean circulation, Ocean currents, Bays, Coasts, Data processing, Spatial distribution, Analytical techniques, *Cook Inlet(AK), Tidal currents, Doppler radar.

Surface currents were measured by using a newly developed high-frequency (HF) Doppler radar technique. The system was operated in lower Cook Inlet, Alaska, in July 1977. During one particular day, July 13, radar data collected every 30 min for 24 hours was analyzed. By least squares fitting these data to two of the dominant tidal periods, 12.31 and 24.6 hours, the spatial distribution of the tidal currents for each of these two periods was determined. In addition, the spatial distribution of the mean surface currents for this 24-hour period was analyzed. Analysis of this data showed that near Kachemak Bay there is a distinct difference of the east-west component of tidal flow in comparison with regions further from Kachemak. In addition, longer period components were observed for which the period could not be determined. These components exhibited gyrelike spatial patterns. Results demonstrated the use of HF radar techniques for resolving spatial and temporal currents which affect the nearshore environment. (Sims-ISWS)
W80-04307

SYMPOSIUM ON GLACIER BEDS: THE ICE-ROCK INTERFACE.
For primary bibliographic entry see Field 2C.
W80-04313

DEPOLARIZATION OF RADIO WAVES CAN DISTINGUISH BETWEEN FLOATING AND GROUNDED ICE SHEETS,
Natural Environment Research Council, Cambridge (England). British Antarctic Survey.
For primary bibliographic entry see Field 2C.
W80-04328

A SIMPLE TUBULAR PHYTOPLANKTON SAMPLER FOR VERTICAL PROFILING IN LAKES,
Ontario Ministry of the Environment, Ottawa. Water Resources Branch.
K. H. Nicholls.
Freshwater Biology, Vol 9, No 2, p 85-89, April 1979. 2 Fig, 7 Ref.

Descriptors: *Phytoplankton, *Equipment, *Water sampling, Buckskin Lake, Ontario, Tadenac Lake, Sampling, Depth, Materials, Testing procedures, Water analysis, Lakes, Data collections, Biomass, Algae, Epilimnion, Hypolimnion, Canada.

This paper describes a tubular phytoplankton sampler which offers versatility not available in other samplers and which is simply and inexpensively constructed. By pooling samples from a 2 m or 3 m tube, a composite sample of any selected depth interval can be obtained. The sampler consists of a tube with an exterior valve mechanism at the lower end which opens when the sampler is lowered and closes when it is raised. A capping plate at the top opens the tube to lakewater passing through it during descent and closes off the top when the tube travels upward to the lake surface. Opening and closing is activated by water pressure exerted on two exterior vanes, avoiding a messenger-activated closing mechanism. The new sampler collected phytoplankton from Buckskin and Tadenac Lakes, Ontario, August 1977. In each lake, maximum phytoplankton density was not in the epilimnion but in the metalimnion or upper hypolimnion. In both lakes, certain chrysophytes had distinctly higher densities below the epilimnion. (Danovich-Wisconsin)
W80-04344

7C. Evaluation, Processing and Publication

EFFECT OF AGRICULTURE ON CEDAR LAKE WATER QUALITY,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 2H.
W80-04206

STAINING PREPARATIONS FOR PHYTOPLANKTON AND PERIPHYTON,
NUS Corp., Pittsburgh, PA. Ecological Sciences Div.
B. B. Owen, Jr., M. Afzal, and W. R. Cody.
British Phycological Journal, Vol 13, No 2, p 155-160, June 1978. 3 Tab, 10 Ref.

Descriptors: *Phytoplankton, *Analytical techniques, *Methodology, *Dyes, *Periphyton, Diatoms, Cytological studies, Algae, Testing procedures, Biomass, Biological communities, Microscopy, Testing, Evaluation, Water analysis, Laboratory tests.

Phytoplankton and periphyton can be studied on the same slides by staining preserved samples with acid fuchsin, dehydrating them and then preparing membrane-filter (phytoplankton) or slurry (periphyton) microscope mounts. The methods provide a single preparation procedure for phytoplankton or periphyton samples, allowing investigators to study diatom and non-diatom components in detail and to distinguish diatoms alive at collection from those already dead, based on visible cell contents. The ability to distinguish between live and dead diatoms provides information more ecologically meaningful than that generated by methods based upon cleaned diatom studies. Procedures described in this result mostly from excessive filtration vacuum rather than from loss of material during preparation. However, no significant differences occur in ratios of live, dead, and broken diatoms after sample preparation by wet mounts, centrifuging or sedimentation. The staining methods presented offer attractive alternatives to conventional methods, especially when the algal communities being studied contain large diatom numbers. (Danovich-Wisconsin)
W80-04365

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1978--VOLUME 1. GREAT BASIN AND SNAKE RIVER BASIN ABOVE KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-155542, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ID-78-1, September 1979. 457 p, 12 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Great Basin, *Snake River basin(Idaho).

Water resources data for the 1978 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 24 lakes and reservoirs; water-quality for 103 gaging stations, 48 partial-record stations, and 179 wells; and water levels for 429 observation wells. Also included are data for 57 crest-stage partial-record stations and 191 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (Kosco-USGS)
W80-04366

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1978--VOLUME 2. UPPER COLUMBIA RIVER BASIN AND SNAKE RIVER BASIN BELOW KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-155559, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ID-78-2, September 1979. 377 p, 22 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Upper Columbia River basin(Idaho), Snake River basin(Idaho).

Water resources data for the 1978 water year for Idaho consist of records of stage, discharge, and water quality of streams, stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 24 lakes and reservoirs; water-quality for 103 gaging stations, 48 partial-record stations, and 179 wells; and water levels for 429 observation wells. Also included are data for 57 crest-stage partial-record stations and 191 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (Kosco-USGS)
W80-04367

RAINFALL-RUNOFF DATA FROM SMALL WATERSHEDS IN COLORADO, OCTOBER 1974 THROUGH SEPTEMBER 1977,
Geological Survey, Lakewood, CO. Water Resources Div.
B. J. Cochran, H. E. Hodges, R. K. Livingston, and R. D. Jarrett.
Available from: OFSS, USGS Box 25425, Fed. Ctr. Denver, CO Pc $3.25 Mf $3.50. Geological Survey open-file report 79-1261, August 1979. 673 p, 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Rainfall-runoff relationships, *Basic data collections, *Hydrologic data, *Small watersheds, *Colorado, Streamflow, Gaging stations, Discharge measurement, Rain gages, Storms, Storm drains, Urban hydrology, Urban runoff, Denver(Colo).

Rainfall-runoff data from small watersheds in Colorado are being collected and analyzed for the purpose of defining the flood characteristics of these and other similar areas. Data collected from October 1974 through September 1977 at a total of 18 urban stations, 10 Denver Federal Center stations, and 48 rural (or highway) stations are tabulated at 5-minute time intervals. Additional information presented includes station descriptions and methods of data collection and analysis. (Kosco-USGS)

W80-04371

STORMWATER-RUNOFF DATA FOR A MULTIFAMILY RESIDENTIAL AREA, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. Hardee, R. A. Miller, and H. C. Mattraw, Jr.
Available from: OFSS Bx 25425, Fed. Ctr. Denver, CO, paper copy $9.00 microfiche $3.50. Geological Survey open-file report 79-1295, 1979. 68 p, 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Urban runoff, *Water quality, *Florida, Hydrologic data, Rainfall, Chemical analysis, *Dade County(Fla), Residential area.

Rainfall, stormwater discharge, and water-quality data for a multifamily residential area in Dade County, Florida, are summarized. Loads for 19 water-quality constituents were computed for runoff from 16 storms from May 1977 through June 1978. The 14.7 acre basin contains apartment buildings with adjacent parking lots. The total surface area consists of 70.7 percent impervious material. (Kosco-USGS)
W80-04375

WATER RESOURCES OF THE SANTA ROSA INDIAN RESERVATION AND VICINITY, RIVERSIDE COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-04376

HYDROLOGIC CONDITIONS IN BROWARD COUNTY, FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
T. R. Beaven.
Available from: OFSS U.S. Geological Survey Box 25425, Federal Center Denver, CO, paper copy $13.00 microfiche $3.50. Geological Survey open-file report 79-1258, 1979. 93 p, 47 Fig, 10 Tab, 25 Ref.

Descriptors: *Hydrologic data, *Surface waters, *Groundwater, *Water quality, *Florida, Data collections, Rainfall, Runoff, Streamflow, Water analysis, Water wells, Water utilization, Pumping, Withdrawal, Groundwater recharge, Aquifer characteristics, Hydrographs, Water pollution sources, Water management(Applied), Broward County(Fla).

During the 1976 water year, rainfall was 3.6 percent below average in Broward County, Fla. Water levels in the Pompano Beach and Dixie well fields were lower during the peak of the 1976 dry season than the peak of the record low dry season in 1971. Flow in the major canals was variable during the 1976 water year compared to 1962-75 averages. Flows in Cypress Creek, Middle River, and Snake Creek at S-29 were higher than the average. Flows in Plantation Canal and South New River were equal to the 1962-75 averages, while Hillsboro, North New River, and Snake Creek at N.W. 67th Avenue were below the long-term averages. The concentrations of principal mineral constituents in surface water in Broward County were within limits established by Florida State Water Standards, with the exception of iron at one station. Total coliforms were equal to or within permissible limits for class III water and waters for public supply in Broward canals at all sites during the 1976 water year. Fecal coliform did not exceed the permissible limit for public water supply at any of the sites during the 1976 water year. (Kosco-USGS)
W80-04378

HYDROGEOLOGIC FEATURES OF THE ALLUVIAL DEPOSITS IN THE NOWOOD RIVER DRAINAGE AREA, BIGHORN BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-04382

HYDROLOGIC AND RELATED DATA FOR WATER-SUPPLY PLANNING IN AN INTENSIVE-STUDY AREA, NORTHEASTERN WICHITA COUNTY, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-04385

THE CALIFORNIA WATER ATLAS.
California Office of Planning and Research, Sacramento.
For primary bibliographic entry see Field 2A.
W80-04444

A COMPENDIUM OF LAKE AND RESERVOIR DATA COLLECTED BY THE NATIONAL EUTROPHICATION SURVEY IN EASTERN NORTH-CENTRAL, AND SOUTHEASTERN UNITED STATES.
National Eutrophication Survey, Corvallis, OR.
For primary bibliographic entry see Field 5C.
W80-04458

8. ENGINEERING WORKS

8A. Structures

DESIGN CRITERIA FOR COOLING-WATER OUTLET STRUCTURES,
Karlsruhe Univ., (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W80-04310

SUBGLACIAL CONSTRUCTIONS AND INVESTIGATIONS AT BONDHUSBREEN, NORWAY,
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2C.
W80-04339

DOWN EASTERS HEAD FOR THE BEDROCK.
Ground Water Age, Vol 14, No 5, p 25, 28, January, 1980.

Descriptors: *Maine, *Bedrock, *Water wells, *Drilling, Dug wells, Well regulations, Municipal water, Aquifers, Granites.

Residential water wells in Maine, which are underlain by granite, are either shallow, dug wells in glacial drift or deep, drilled wells in bedrock well below the water table. Municipal wells require more water than most aquifers in Maine are capable of producing. Finding adequate aquifers requires exploratory drilling in valleys. Maine is one of the least regulated states in terms of water wells. (Purdin-NWWA)
W80-04434

PERCUSSION DRILLING TECHNOLOGIES,
National Water Well Association, Worthington, OH.
T. E. Gass.
Water Well Journal, Vol 34, No 1, p 29-31, January, 1980. 3 Fig.

Descriptors: *Drilling, *Technology, Drilling equipment, Cable-tool drilling, Developing countries, *Water wells.

In developing countries a hand-dug well requires more time and capital than a drilled well. However, drilled wells are impractical due to high maintenance and operating costs, difficulty in obtaining spare parts and transporting equipment. A more practical approach would be the development of labor-intensive percussion drilling technology. Tripods can be constructed of bamboo, timber, lumber, or scrap metal pipe depending on availability. Vertical reciprocating motion can be produced by means of a spring pole, a lever, or by alternately pulling and releasing a rope. In some areas, a motorized cathead can be used. The dry bucket percussion drilling method is simple and fast as long as the soil adheres to the inside of the bucket. In the bail-down method, water is added to the borehole and the casing is lowered by bailing soil from beneath the casing. Bailers can be constructed from sections of well casing and scrap metal. This method is suitable for large diameter (10-inch) wells in sandy formations. (Purdin-NWWA)
W80-04435

LARGE DIAMETER SHALLOW WELLS.
Canadian Water Well, Vol 6, No 1, p 21, February, 1980.

Descriptors: *Shallow wells, *Water wells, *Construction, Dug wells, Concrete pipes, Water pollution, Heaving, Drying, Water storage, Domestic water.

Hand-dug wells usually have little standing water due to difficulty in digging below the water table. The bucket boring machine and concrete well tiles have overcome this problem. Other problems of dug or bored wells are their susceptibility to pollution, heaving of fine sand and silt, and drying during droughts. However, when properly constructed, bored wells are extremely effective, especially in areas where the rate of aquifer yield is limited or where fine sand prohibits the use of screened wells. Bored wells provide an adequate storage volume for domestic water use where a conventional drilled well cannot. (Purdin-NWWA)
W80-04473

8B. Hydraulics

DISPERSIVITY AND VELOCITY RELATIONSHIP FROM LABORATORY AND FIELD EXPERIMENTS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
For primary bibliographic entry see Field 2F.
W80-04235

SUBMERGED RADIAL HYDRAULIC JUMP,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
J. A. McCorquodale, and A. M. Khalifa.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY3, Proceedings Paper 15250, p 355-367, March 1980. 11 Fig, 12 Ref, 2 Append.

Descriptors: *Hydraulic jump, *Energy dissipation, *Outlet works, *Settling basins, Hydraulics, Dams, Energy, Velocity, Pressure, Sluice gates, Froude number, Laboratory tests, Hydraulic design, *Submerged flow, *Radial flow.

A slight flaring of the side walls of the stilling basin can be advantageous in reducing the exit velocities. The hydraulic jump in such a stilling basin is referred to as a radial hydraulic jump. When the sluice gates discharge directly to the stilling basin, a submerged radial hydraulic jump will probably occur. An experimental study produced surface profiles, bed pressure, and length characteristics for the submerged radial jump. A fourth-degree polynomial was used to describe the surface profile. The submerged radial jump lengths were found to be from 50% to 70% of the corresponding submerged rectangular jump lengths. Improved energy dissipation is also characteristic of the radial jumps. The model consisted of a 1.0-m long stilling basin with a total divergence angle of 13.5 degrees located downstream through a sluice gate. A theoretical equation was proposed to describe the relationship among: gate submergence, exit depth, initial depth, initial Froude number, and basin divergence. (Adams-ISWS)
W80-04311

SUMMARY OF HYDROLOGIC DATA FOR TAMPA BYPASS CANAL SYSTEM, JULY 1974 TO SEPTEMBER 1976,
Geological Survey, Tallahassee, FL. Water Re-

sources Div.
K. W. Causseaux, and H. C. Rollins.
Available from: OFSS, USGS Box 25424, Fed. Ctr. Denver, CO, paper copy $10.00 microfiche $3.50. Geological Survey open-file report 79-1297, 1979. 74 p, 10 Fig, 16 Tab, 1 Ref.

Descriptors: *Hydrologic data, *Canals, *Groundwater, *Surface waters, *Data collections, Flood control, Water wells, Networks, Monitoring, Sampling, Sites, Water quality, Trace metals, Nutrients, Chemical analysis, Pesticides, Aquifers, Potentiometric levels, Discharge(Water), Florida, *Tampa Bypass Canal(Fla).

The Tampa Bypass Canal is part of a flood-control project east of the city of Tampa, Fla., under construction by the U.S. Army Corps of Engineers. It will divert floodwater from the Hillsborough River at points upstream from Tampa through a canal system to McKay Bay. The U. S. Geological Survey began a hydrologic data program in 1974 to provide data needed to identify existing hydrologic conditions and to evaluate the effects of canal construction. A network of surface-water and ground-water sites was designed to monitor changes in nutrients, trace metals, inorganic constituents, pesticides, and benthic invertebrates along the canal system; to monitor changes in trace elements, common constituents, nitrates, specific conductance, and chlorides in the Floridan aquifer; and to monitor changes in the potentiometric surface of the Floridan aquifer. In 1974-75, the monitoring program consisted of drilling 12 monitor wells and initiation of the surface-water sampling program. In 1976, the program consisted of drilling 5 additional wells, continuation of the surface-water sampling, initiation of ground-water sampling program, and monitoring of discharge from springs. Water-quality data for 9 surface-water sites in the basin were collected at each of the control structure sites, in the tidal portion of the canal, and at each of the major tributaries to the canal system. (Kosco-USGS)
W80-04373

8C. Hydraulic Machinery

GROUND WATER HEAT PUMPS - A COST COMPARISON,
Wilson (Ian D.) Associates Ltd., Barrie (Ontario).
For primary bibliographic entry see Field 6B.
W80-04424

8D. Soil Mechanics

LARGE DIAMETER SHALLOW WELLS.
For primary bibliographic entry see Field 8A.
W80-04473

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

SOME BASIC CONCEPTS OF WAVE SEDIMENT TRANSPORT,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 2J.
W80-04304

SYMPOSIUM ON GLACIER BEDS: THE ICE-ROCK INTERFACE.
For primary bibliographic entry see Field 2C.
W80-04313

PROCESSES OF GLACIER EROSION ON DIFFERENT SUBSTRATA,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W80-04314

LOCAL FRICTION LAWS FOR GLACIERS: A CRITICAL REVIEW AND NEW OPENINGS,
Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
For primary bibliographic entry see Field 2C.
W80-04318

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